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THE TOOL ENGINEER

REG. U.S. TRADE MARK

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Communications Is the Answer . . . . . *By R. B. Douglas* 1

Development and Effects of the Revised Screw Thread Standard . . . . . *By E. J. Bryant* 17

Engineering Refresher Courses for State Licensing Examinations . . . . . *By John J. Uicker* 21

Computing Torque, Thrust and Horsepower for Counterbores . . . . . *By G. F. Bush* 23

Seam Welding and Miscellaneous Welding Processes . . . . . *By E. J. Del Vecchio* 26

Components and Applications of Industrial Hydraulic Systems. . . . . . *By A. G. Winchester* 28

Some Influencing Factors in Tool Steel Heat Treatment . . . . . *By E. J. Pavesic* 32

Milling Cutter Design and Operation . . . . . *By Mario Martellotti* 34

Designing Extrusion Dies for Complicated Sections . *By Carl Dovano* 38

Metal Requirements for Aluminum Presswork . *By J. W. Lengbridge* 40

Tool Engineering Data 49

Departments

Andygrams, 51 ● ASTE News, 52 ● Gadgets, 46 ● Good Reading, 80 ● North, East, West, South in Industry, 78 ● Tools of Today, 69 Trade Literature, 48 ● Index to Advertisers, 112

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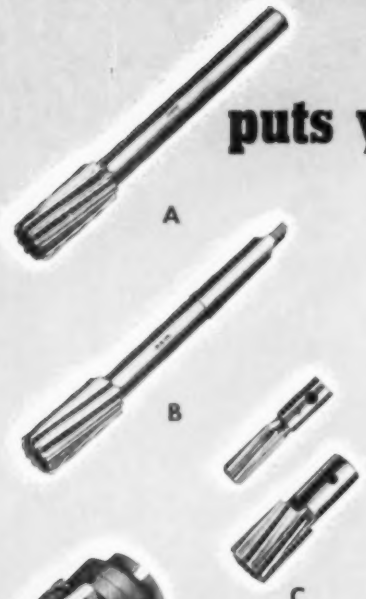

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July, 1949

Vol. XXIII, No. 1

Editorial

Communications Is the Answer

EVERY EVIDENCE points to the fact that technologically, we are on top of the heap. A great body of evidence shows rather conclusively, however, that while we have been building this huge resevoir of technical skill, we have neglected the development of certain elements—the lack of which can bring doom and disaster to the institutions we have so carefully built.

Possibly the most important among these neglected elements is this thing we call "human relations." Boiled down to its essentials, human relations is nothing more or less than the techniques for conveying facts and ideas, an efficient system of communication. The record shows clearly that we have been inept in the communication of ideas—and of the information which creates understanding among people who work together in an enterprise.

Proof of this statement can be found in a study made last year by Opinion Research Corporation. These researchers found that twenty-four percent of the American people lean definitely toward some drastic, fundamental change in our social, political and economic system.

Further study of Opinion Research Corporation's report shows that misinformation or lack of information is largely responsible for the attitudes and beliefs which have led to the condition. For example, two-thirds of the public generally believes that industrial profits average about 20 percent on sales. The guesses ran as high as 60 percent. Employees of industry thought profits ran about 25 percent of sales.

As engineers, concerned daily with costs, you know that industrial profits now average about 5.1 percent of sales, after taxes.

Workers as a whole expressed their belief that management receives about 75 cents of the company dollar available for wages and salaries, and that labor gets only 25 cents. The fact is that labor gets 87 cents and that only 13 cents is received by the owners and managers. Only one worker in five is aware of having received any information whatever from his employer about profits and wages.

People who live on farms seem to have a better understanding of each other than do workers and managers in industry. That is probably because each rural worker knows the other so well. The connection between cause and effect on a farm is so plain and easy to see. Industry, more complex and more widely spread, naturally has a greater distance between cause and effect.

It is therefore, in order for us to give some thought to the causes of this condition, and what we as tool engineers can do to help remedy the malignant disease.

In the first place, Opinion Research found that people who are satisfied with their jobs tend to approve of the economic system. It is then up to us, with our managements, to make people satisfied with their jobs. We must realize that what makes them dissatisfied is usually lack of understanding and fear. Certainly tool engineers, who come in contact every day with the workers in their respective plants, can do a great deal toward bringing about better understanding by simply giving to the workers the correct information about the company and its product. This will eliminate fear, because we tend to fear only the unknown.

Good, honest conversation with employees will also increase productivity. Engineers who have studied conditions in all types of plants agree that output per man hour can be increased up to fifty percent by cooperative worker attitudes.

One observer has asked: "If the people who work in an industry lack an affirmative faith in what they are doing, how can their neighbors believe in the institution they represent?"

It seems logical, therefore, that we must begin by selling the workers on the social values of the industries for which they work. It seems to follow that tool engineers are close to the heart of the problem, because they understand production and profits and their relationships each to the other. Tool engineers are also close both to labor and to management.

Let us then take stock, look about, and do our part in finding the highway of communications and understanding leading to cooperation, peace and continued freedom.

R. B. Douglas

President 1948-49

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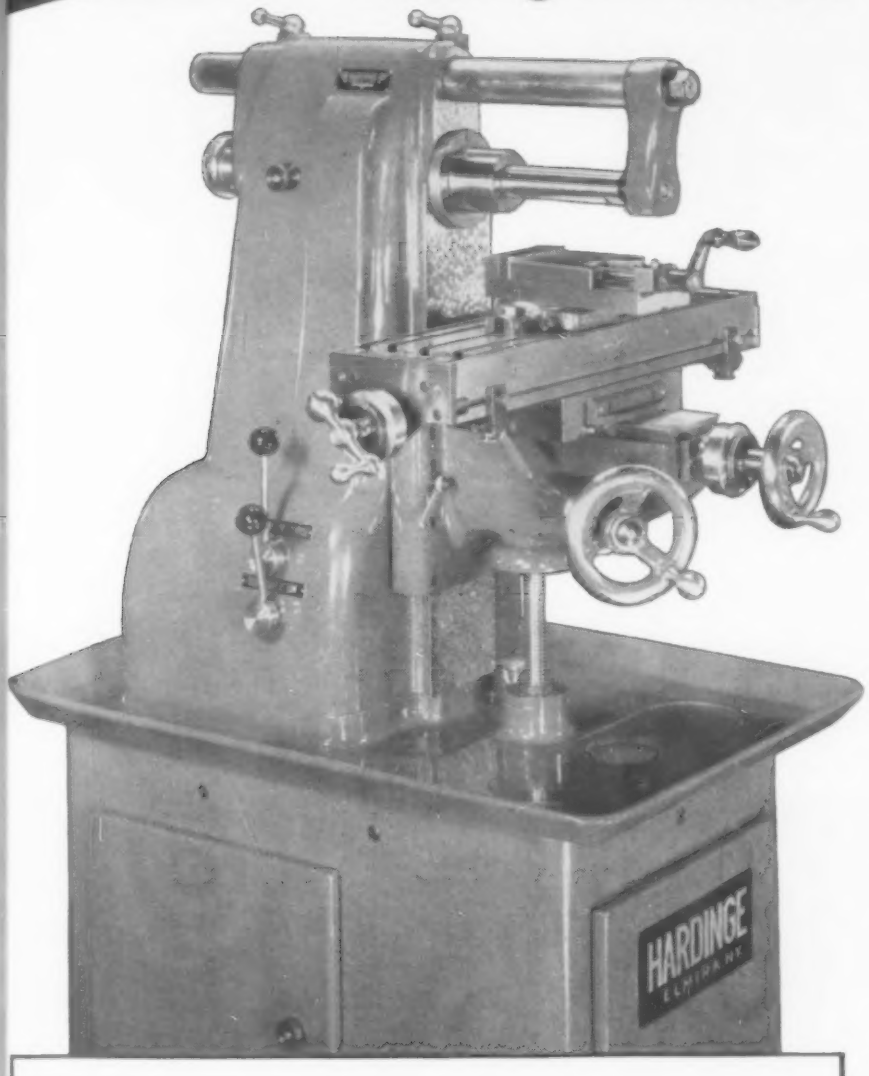

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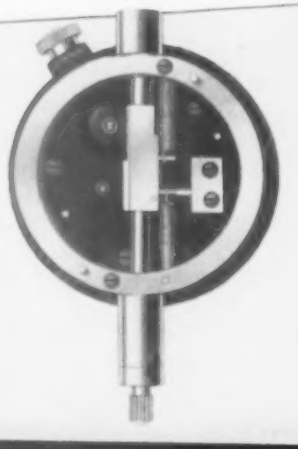

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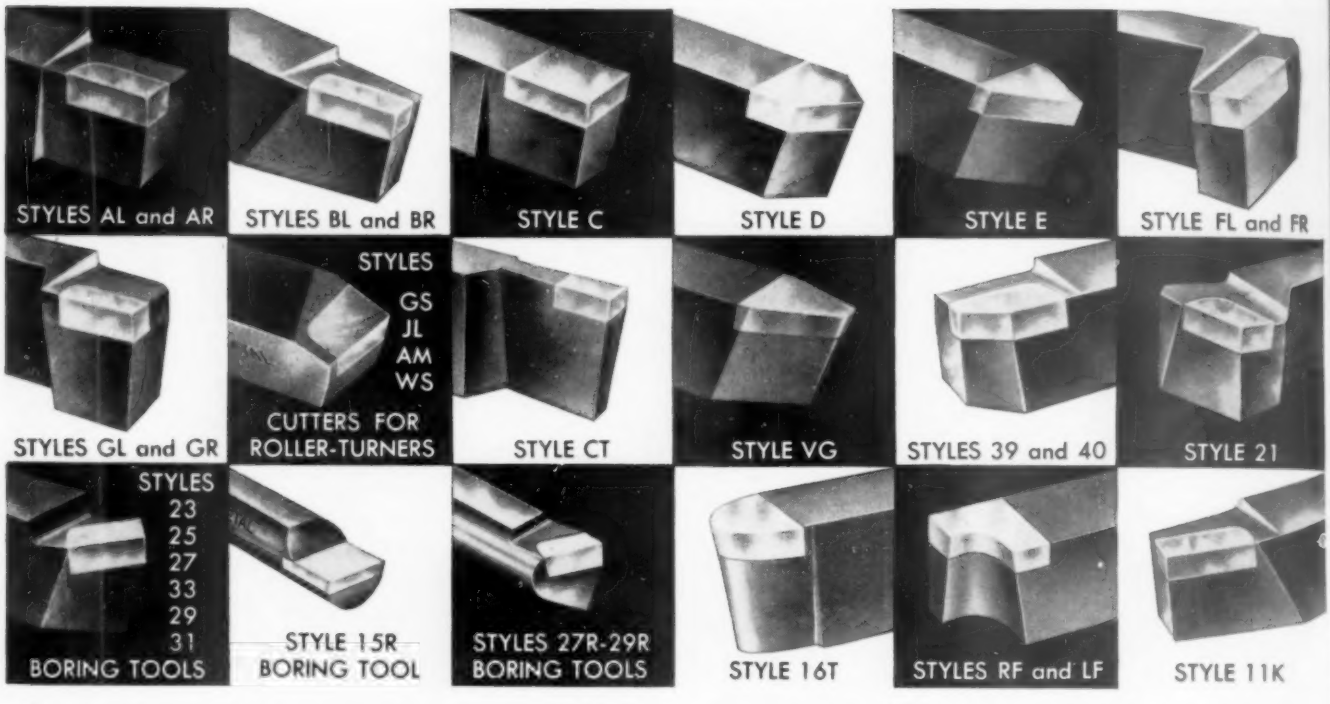

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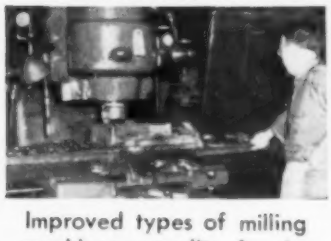

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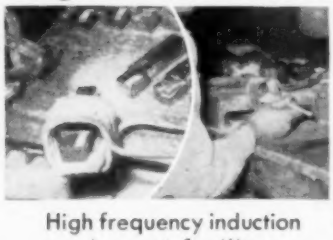

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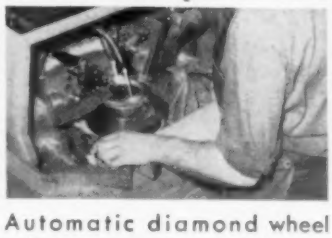

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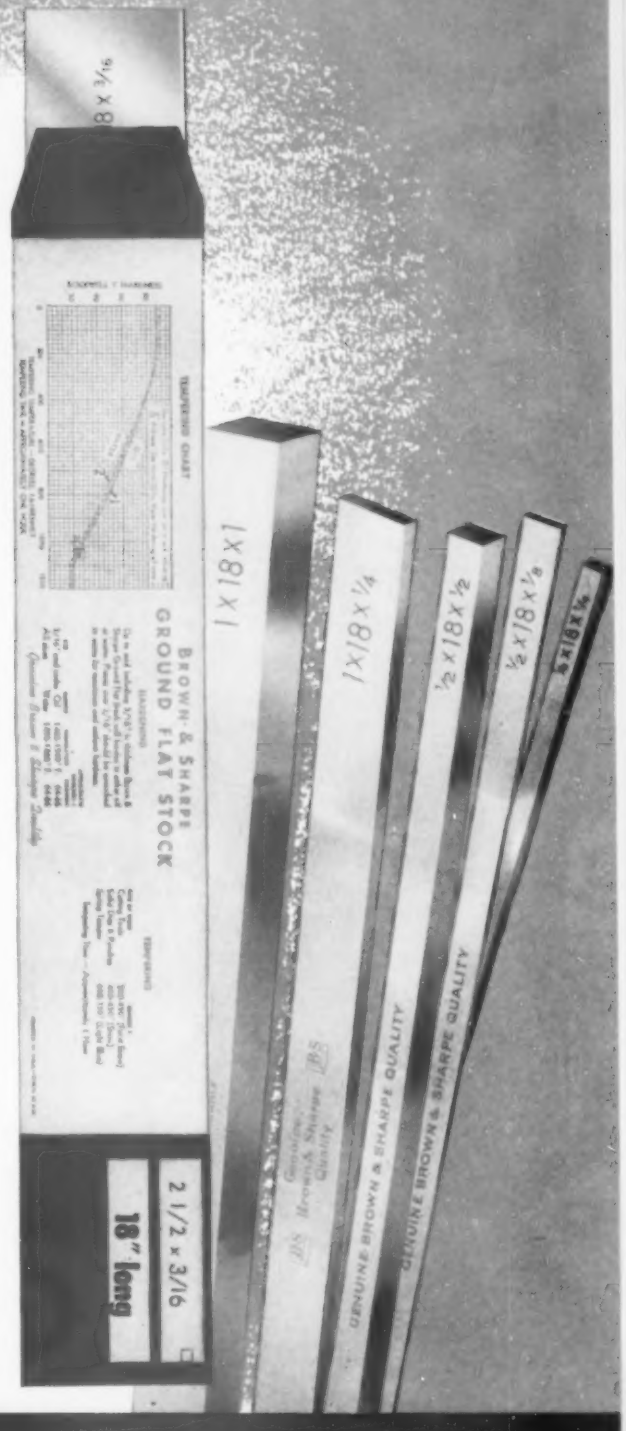

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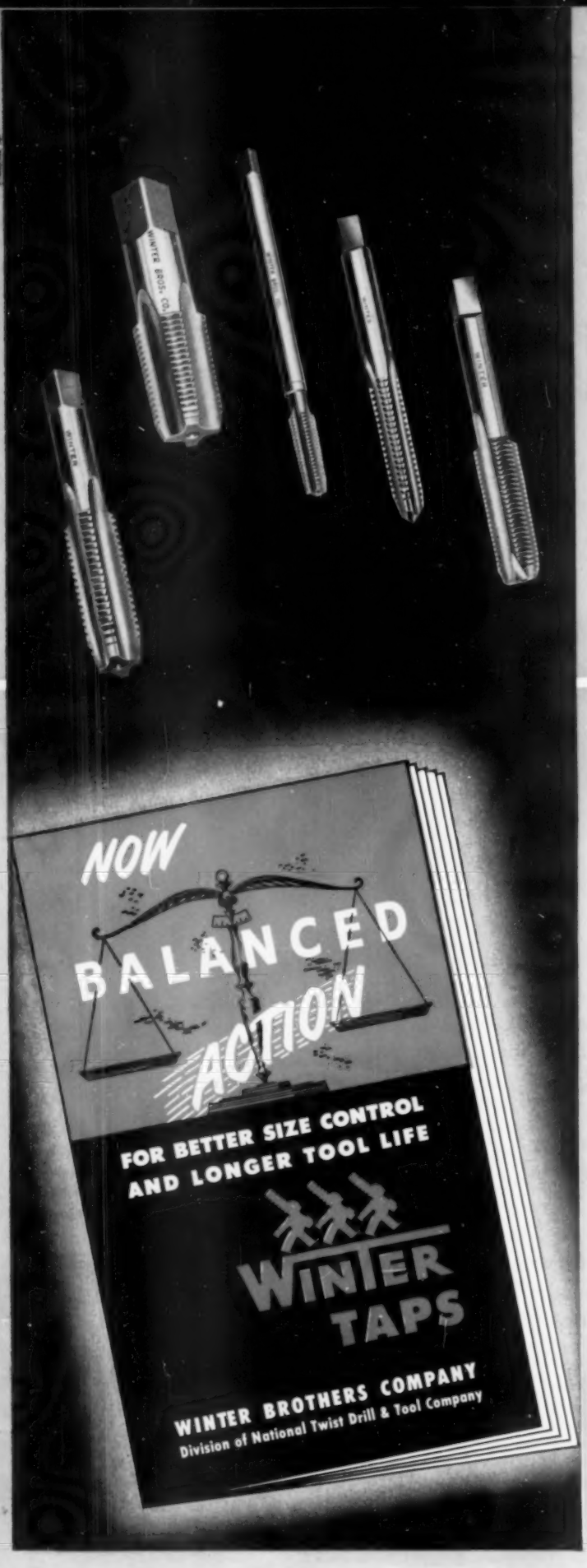

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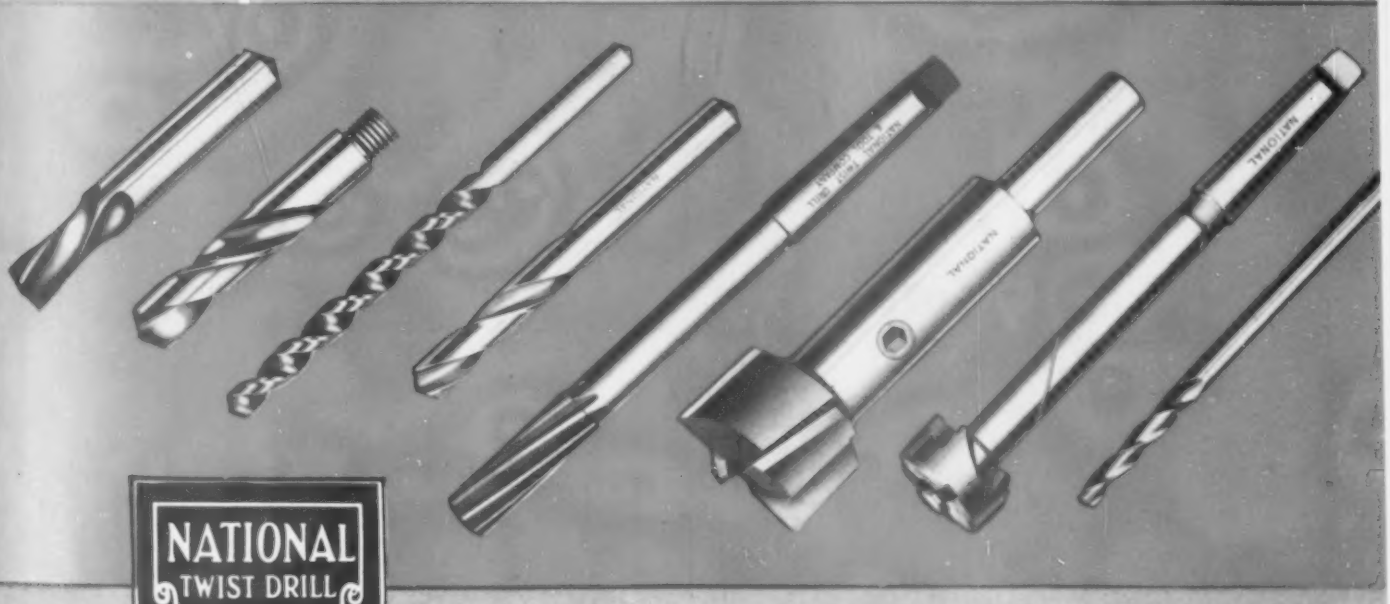

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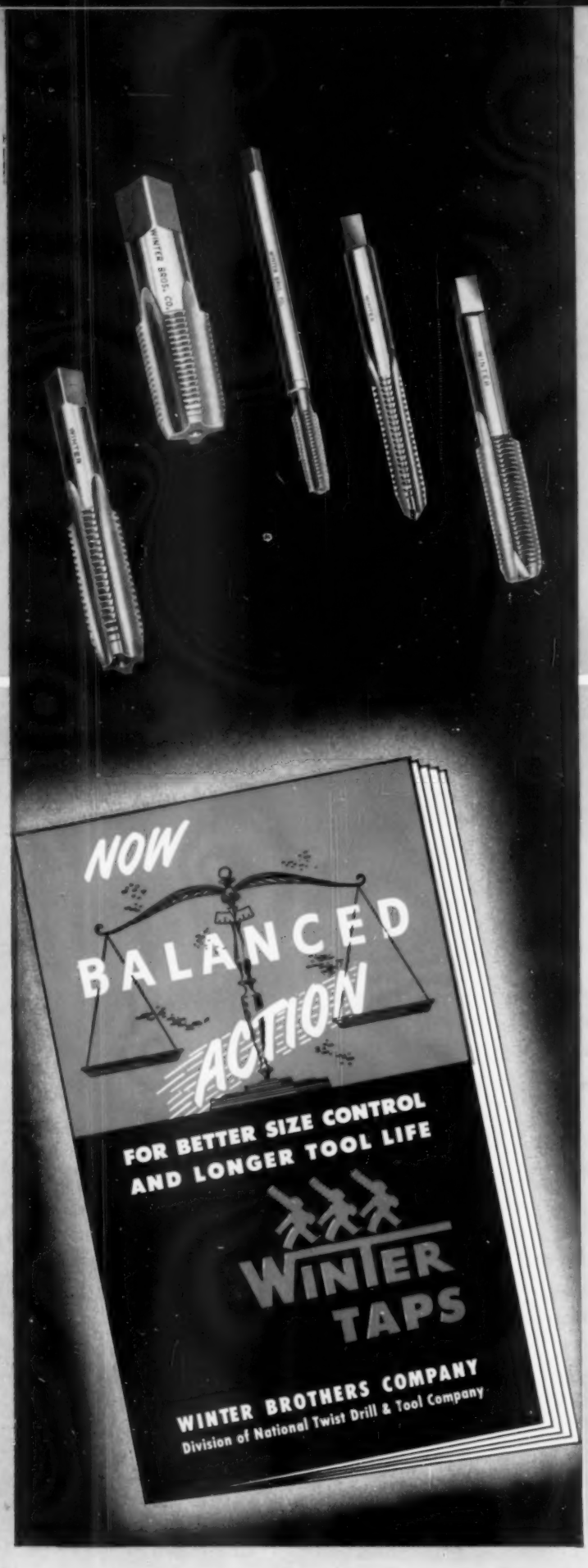

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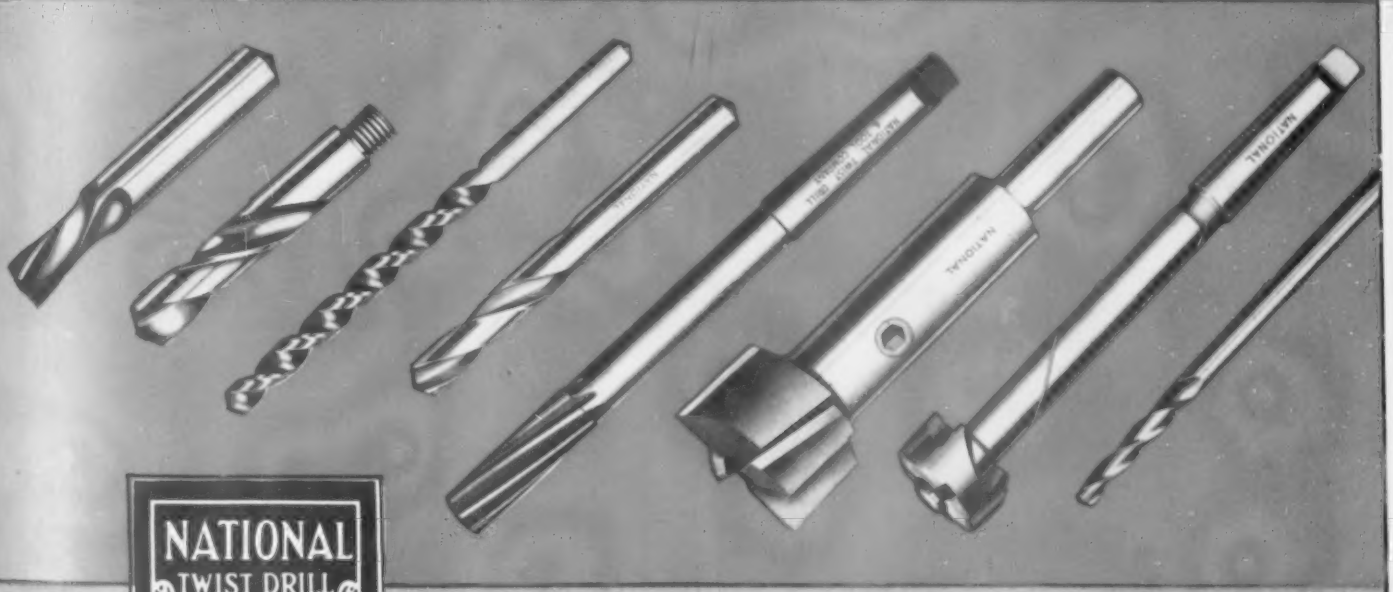

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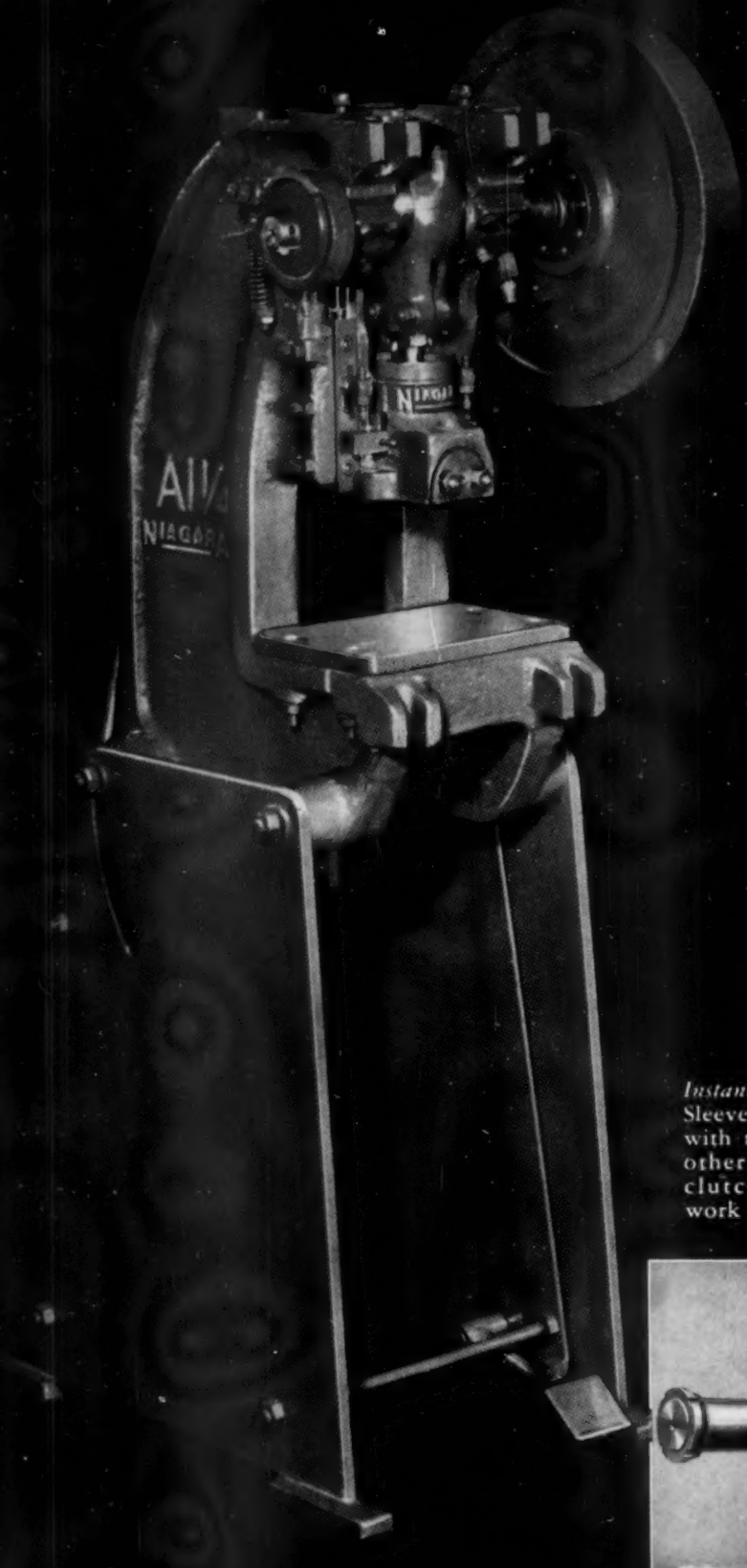

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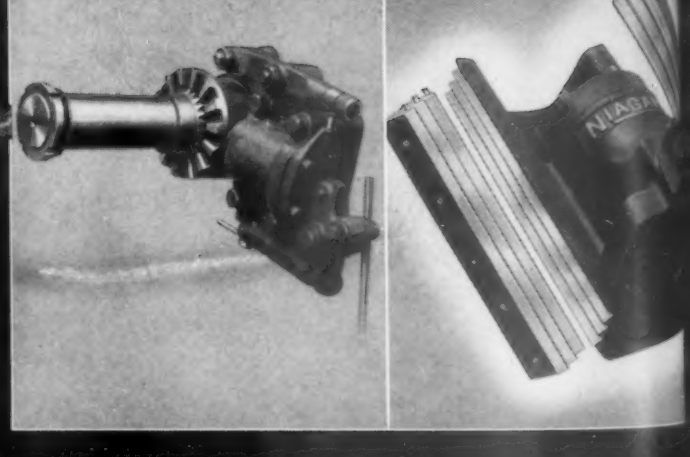

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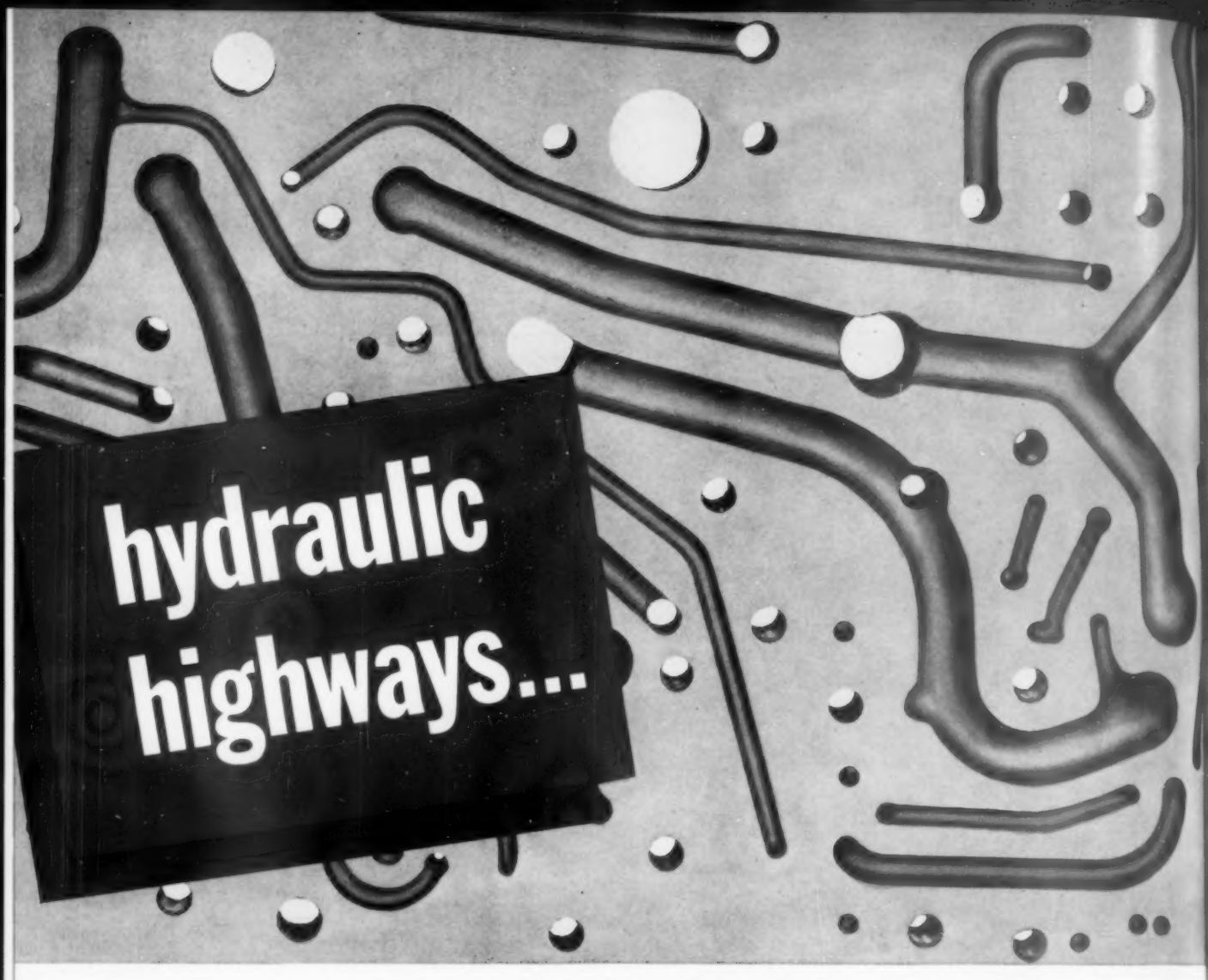

The manifold transfer plate controls flow of oil for various Heald machine cycle operati
Application of this exclusive feature eliminates yards of troublesome pip

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Through this intricate pattern of cored-out steel passages, flows the hydraulic fluid that controls the high-speed, automatic cycles of a Heald machine. For this is a close-up view of the Heald manifold transfer plate — an exclusive feature that provides fast, faultless control of volume and direction, without a maze of complicated, troublesome, and costly piping.

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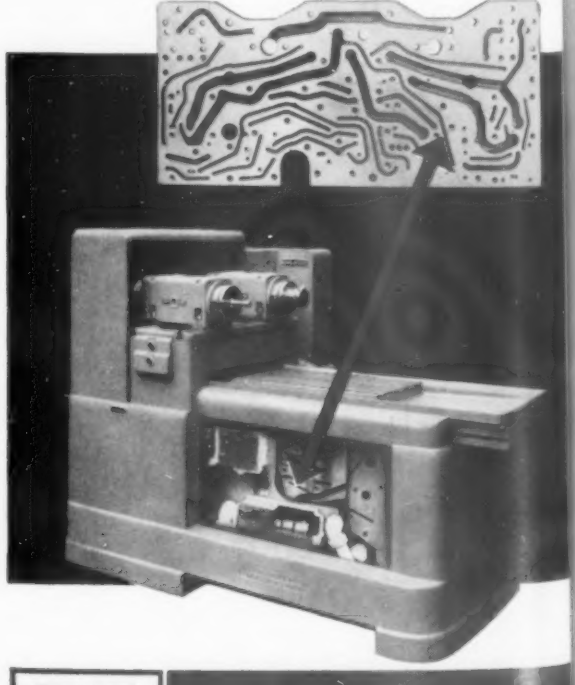

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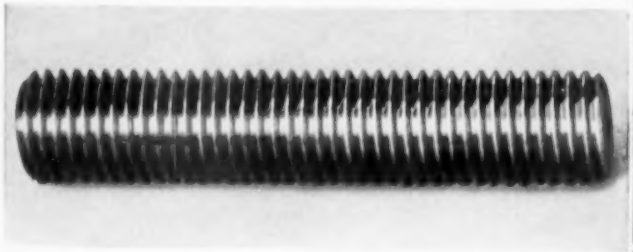
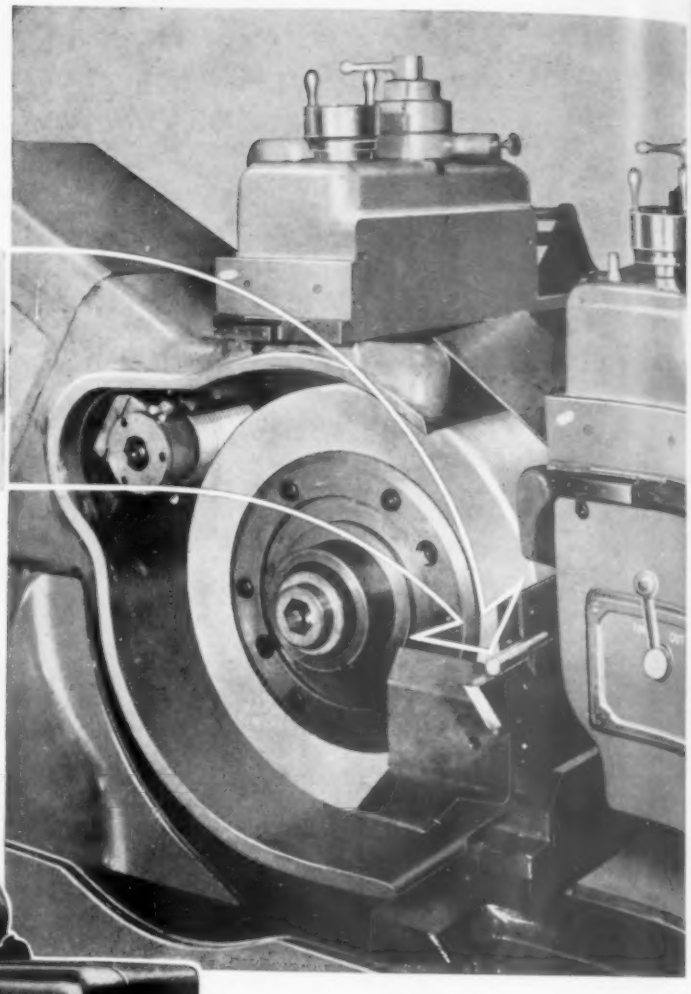
CENTERLESS THREAD GROUND BY THE "THRU-FEED" METHOD





Name of Part.....Stud
Thread Specifications:
Diameter.....3/4"
Pitch.....10 USF
Thread Length.....4"
Thread Tolerance.....Class 7
Production Per Hour.....210

● *The LANDIS No. 1 CENTERLESS THREAD GRINDING MACHINE*

● The LANDIS No. 1 Centerless Thread Grinder is designed to grind screw threads on straight cylindrical workpieces and headed or multiple diameter parts.

Workpieces without interfering shoulders requiring threads on the maximum diameter only are ground by the "thru-feed" method—headed or shouldered workpieces by the "in-feed" method.

Either process will grind threads from the solid or finish grind precut threads. Most types of thread forms can be ground to any required class of fit and for right or left hand threads.

Write for Bulletin E-97

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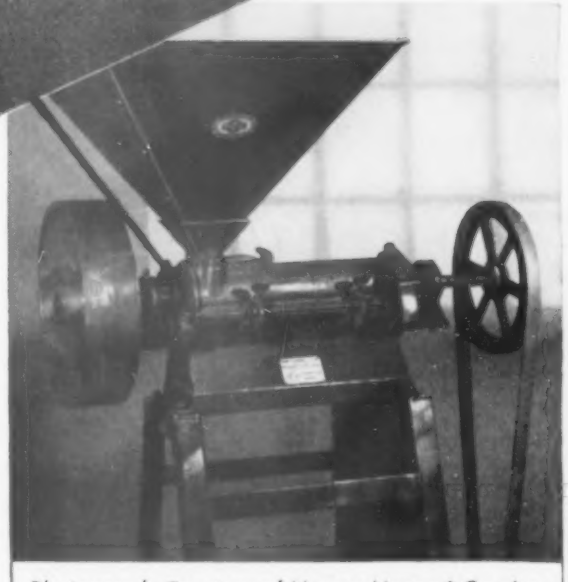

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● Bay State abrasive shell liners are used in hulling machines for removing the bran and shining the wheat grain before it is made into puffed wheat.

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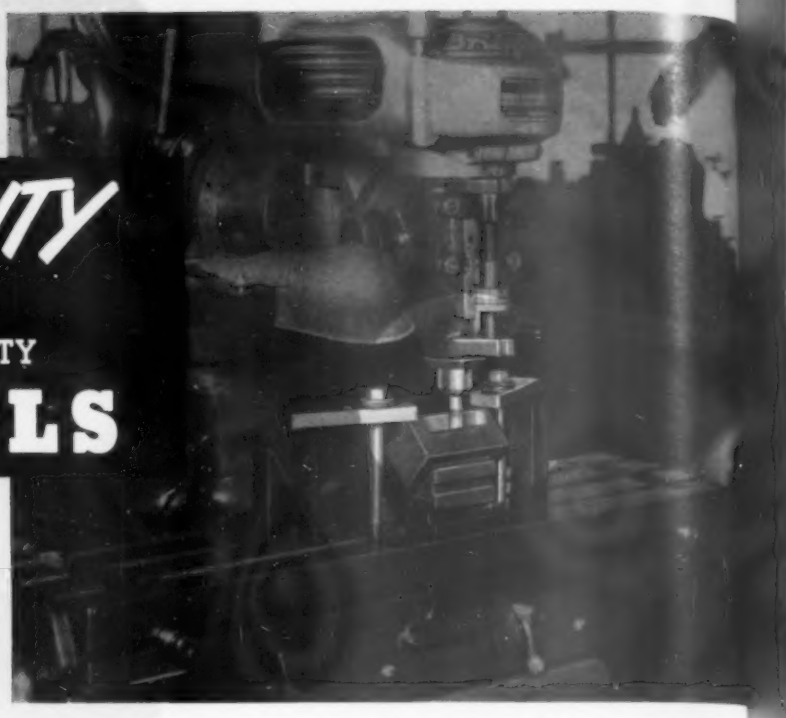

Machining Cobalt Chrome Die Steel at Brooke Russell Products.

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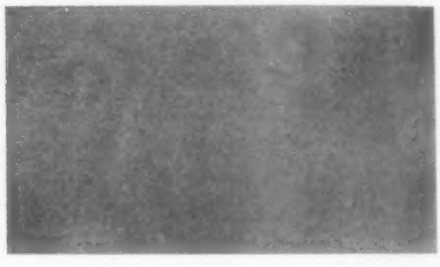

The uniform cross section of this bar of Latrobe's Desegatized Brand Cobalt Chrome Die Steel means greatly improved machinability with less damage to cutting tools while saving costly cutting time.

Large masses of hard carbide segregates seen in the center of this bar of ordinary die steel cause chattering, rapid tool dulling, and expensive machining time.

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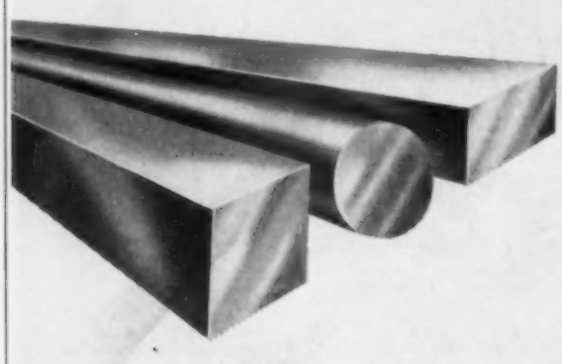

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Development and Effects of the Revised Screw Thread Standard

By E. J. Bryant

CHAIRMAN SECTIONAL COMMITTEE ON STANDARDIZATION AND UNIFICATION OF SCREW THREADS

ONE OF THE last formal steps in the presentation to industry of an international unified screw thread standard, the B1—1—1949 Report on the Standardization of Screw Threads, published under ASME sponsorship, has now been made available.

In December of 1943, British delegates appointed by the Ministry of Production, attended a conference in New York arranged by a special sub-committee of the Combined Conservation Committee, to discuss standards and screw threads. The discussion centered particularly about Acme threads and an American war standard for screw threads of truncated Whitworth form, which was based on a development of our Ordnance Department under the direction of Col. H. B. Hambleton, chief of the gage section of the Ordnance Department at that time. At this meeting the project of again reaching an agreement on a unified standard of screw threads for Great Britain, Canada and the United States was instituted. This was the second such proposal—after World War I an attempt was made to reach an agreement; a delegation was sent from this country to England and France but nothing was accomplished.

The Combined Production and Resources Board, which was formed to help the war effort in allied countries, took interest in the project and arranged for a United States-Canadian-British meeting to discuss thread specifications of all types, in addition to Engineering standards for fit. A series of committee meetings was held in London in August-September of 1944. The writer was chairman, and James G. Morrow, chairman, Canadian Engineering Standard Association, and metallurgical engineer, The Steel Company of Canada, Ltd., Hamilton, Ontario, was vice chairman of the United States-Canadian delegates. For the British, Stanley

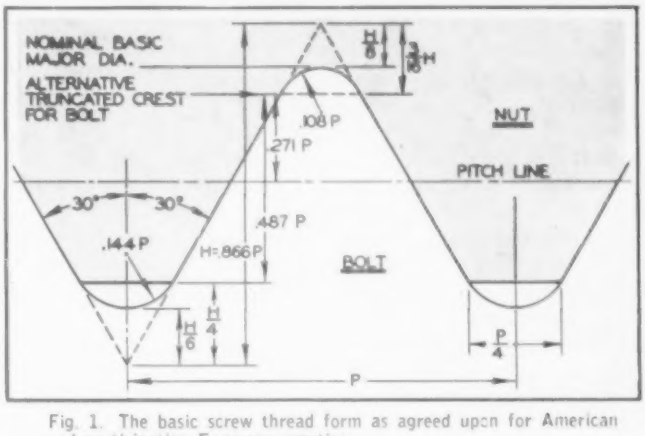

Fig. 1. The basic screw thread form as agreed upon for American and participating European practice.

J. Harley, controller of jigs, tools, and gages, Machine Tool Control, Ministry of Supply; chairman B. S. I. Committee on Taps and Dies, was chairman. Percy Good, director, British Standards Institution, C. B. E. was vice chairman. Numerous meetings were held and some agreement resulted for the Unified Screw Thread Project. It was agreed to make tests to determine the relative merit of various angles for a screw thread so that the standards would be based on known facts. This work was immediately put in progress in Great Britain, Canada and the United States.

In September and October of 1945, joint U.S.-British-Ca-

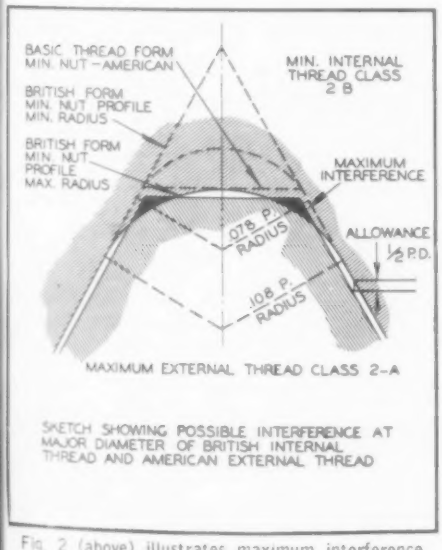
BASIC THREAD FORM MIN. NUT—AMERICAN
BRITISH FORM MIN. NUT PROFILE MIN. RADIUS
BRITISH FORM MIN. NUT PROFILE MAX. RADIUS
MIN. INTERNAL THREAD CLASS 2B
MAXIMUM INTERFERENCE
.078 P RADIUS
.108 P RADIUS
ALLOWANCE ½ P.D.
MAXIMUM EXTERNAL THREAD CLASS 2-A
SKETCH SHOWING POSSIBLE INTERFERENCE AT MAJOR DIAMETER OF BRITISH INTERNAL THREAD AND AMERICAN EXTERNAL THREAD

Fig. 2 (above) illustrates maximum interference between British and American threads as well as interference between an American thread and a British gage or vice versa.

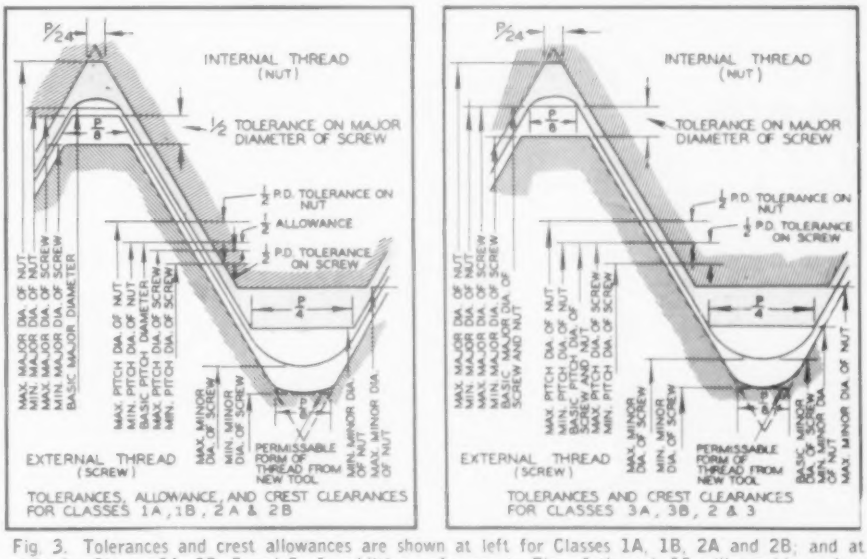
P/24
INTERNAL THREAD (NUT)
½ TOLERANCE ON MAJOR DIAMETER OF SCREW
½ P.D. TOLERANCE ON NUT
½ ALLOWANCE
½ P.D. TOLERANCE ON SCREW
P/4
P/8
EXTERNAL THREAD (SCREW)
PERMISSABLE FORM OF THREAD FROM NEW TOOL
TOLERANCES, ALLOWANCE, AND CREST CLEARANCES FOR CLASSES 1A, 1B, 2A & 2B
TOLERANCE ON MAJOR DIAMETER OF SCREW
½ P.D. TOLERANCE ON SCREW
TOLERANCES AND CREST CLEARANCES FOR CLASSES 3A, 3B, 2 & 3

Fig. 3. Tolerances and crest allowances are shown at left for Classes 1A, 1B, 2A and 2B; and at right for Classes 3A, 3B, 2 and 3. In addition, reference to Figs. 4 through 10 will provide a clear idea of the work done by the conferences in setting up standards implemented to the requirements of industry.

nadian meetings were held in Ottawa and after considering the results of the tests and other factors, an agreement was reached on a basic form with a 60 degree angle (see Fig. 1) and on two series of pitches for ¼ to 4 in. diameter. The tolerances, allowances and gaging were to be worked out later.

Decide to Provide Allowance

In 1940, the increasing use of power drivers for threaded assemblies emphasized the need for an allowance in the thread to prevent seizing or galling, and this was discussed at several meetings. In 1945 at a series of Joint Industry Conferences, the need for an allowance was discussed with consideration for plated screw products. At that time it was agreed that the importance of pitch diameter fit on strength, work load capacity, fatigue and permanence of thread fastenings had been over-rated; that lead, ductility of materials, avoidance of stress concentration, proper lightening and many other factors influence performance more than a slight loss in engagement resulting from a looser fit.

Consideration was given to the possibility that the loads would be more evenly distributed in the looser fits by clearance which would allow members to position themselves over a greater length and area than would be true with a lighter fit. Investigation showed that the tolerances were too restrictive in the number sizes and too liberal in the large fractional sizes, considering present manufacturing practice.

This Joint Industry Conference developed a recommendation to the American Standard Association, B1 Sectional Committee, which included a statement that the allowance was to be placed on the external thread and suggested suitable allowances and tolerances for a new class 2 external thread to be known as a Class B thread. This was an independent movement outside of the B1 Sectional Committee so that when they reached the above recommendation it was turned over to B1; this was done after the Ottawa meeting in which we had reached an agreement on form.

The B1 Committee then started to work out a revised standard giving limits on the basic form adopted at Ottawa, incorporating the industry recommendations which has been submitted, and bringing the standards up to date. The latter would incorporate the latest results of manufacturing and use, and length of engagement, diameter and pitch were considered in determining tolerances for the new standard; thus the ¼-20 Class 2A screw has 0.0033 and ½-20 Class 2A has 0.0045, an increase in tolerance of 0.0012, whereas ¼-20 Class 2 has 0.0031 and ½-20 Class 2, 0.0036, an increase of only 0.0005 in.

In the B1—1—1949 standard, the old Class 2 and 3 are retained; the new classes incorporate the Unified Form and the recommendations of the consumer engineers, and Class 1A, 2A, and 3A for screws; the first two having an allowance. Further agreement included Class 1B, 2B, and 3B for threaded holes, in all of which the minimum hole is basic. (See Fig. 3).

The Class 1A was engineered for a free assembly and for high production, such as ordnance; the Class 2A for the major amount of standard production of screws, bolts and extreme threads. The allowance provides for modern assembly with high speed screw drive and nut runners, and for normal plating or rust proofing.

The Class 1B, 2B, and 3B for nuts and threaded holes was revised to correct inconsistencies that had been found and to give them realistic tolerances from small to large sizes and fine to coarse pitches based on present day use and production methods. For example, pitches on large diameters now have wider tolerance. All sizes of the same class have more nearly the same quality.

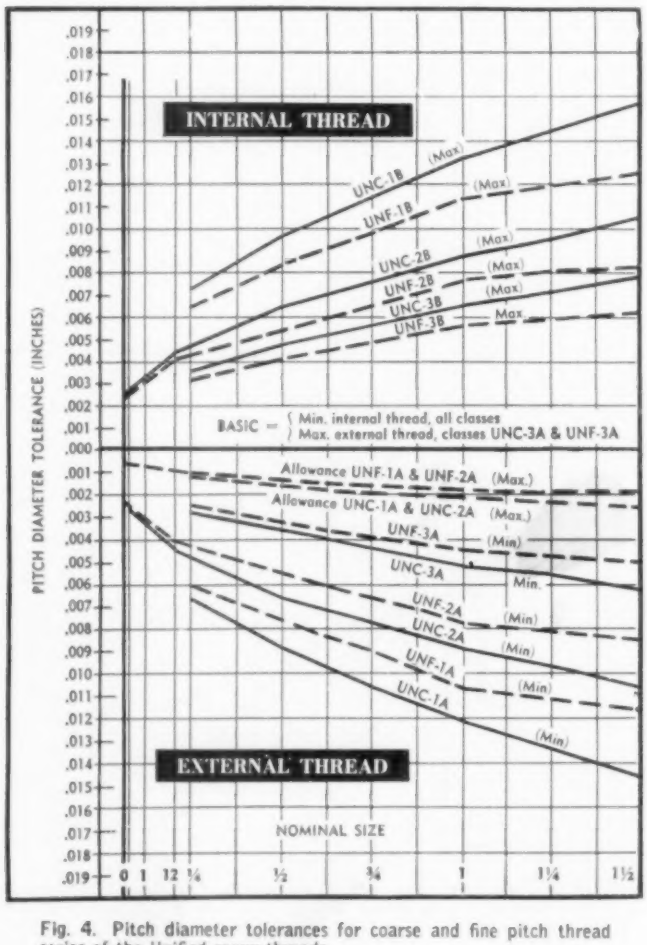

Fig. 4. Pitch diameter tolerances for coarse and fine pitch thread series of the Unified screw threads.

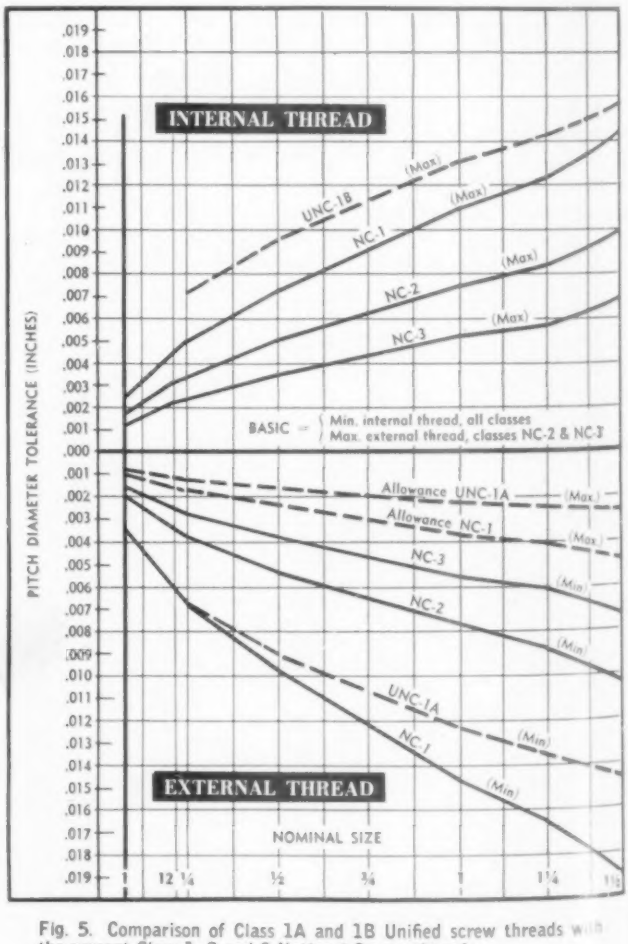

Fig. 5. Comparison of Class 1A and 1B Unified screw threads with the present Class 1, 2 and 3 National Coarse threads.

For the 1B, 2B, and 3B holes in UNC and UNF series of pitches the minor diameters are the same as those for the Class 1, 2, and 3, NC and NF series. The relationship of pitch diameter between the new and old for the three classes of tolerance are shown on charts as follows. The comparison chart, Fig. 4, shows relationship between 1A, 2A, 3A and 1B, 2B and 3B maximum and minimum pitch diameter tolerances. Fig. 5 compares 1A and 1B Unified with Classes 1, 2, and 3 National Coarse Threads. Fig. 6 compares 2A and 2B Unified with Classes 1, 2, and 3 National Coarse Threads. Fig. 7 compares 3A and 3B Unified with Classes 1, 2 and 3 National Coarse. Fig. 8 compares 1A and 1B Unified with Classes 1, 2, and 3 National Fine Threads. Fig. 9 compares 2A and 2B Unified with Classes 1, 2, and 3 National Fine Threads. Fig. 10 compares 3A and 3B Unified with Classes 1, 2 and 3 National Fine Threads. There is a new conception of classes in this report. The "A" Series refers to tolerances for external threads; the "B" Series to tolerances in threaded holes. Three Product classes for both external and internal threading have been worked out. Two of these for the screw have an allowance, the third is without an allowance.

The desired fit is obtained by specifying any combination of the classes of product which give the desired results.

It will be seen that the widest deviation from the old classes is such that the resultant reduction in thread thickness of pitch line, which is approximately the shear point, is slight. The same tooling will produce the new classes. For the Class A screw produced by roll threading, new drawing dies should be made slightly smaller to take full benefit of tolerance. Sharp corners are permitted on cutting dies unless otherwise specified. The maximum and minimum thread gages for the screw should be set to the new limits. The crest of the screw may be rounded, so long as that outside diameter is within tolerance.

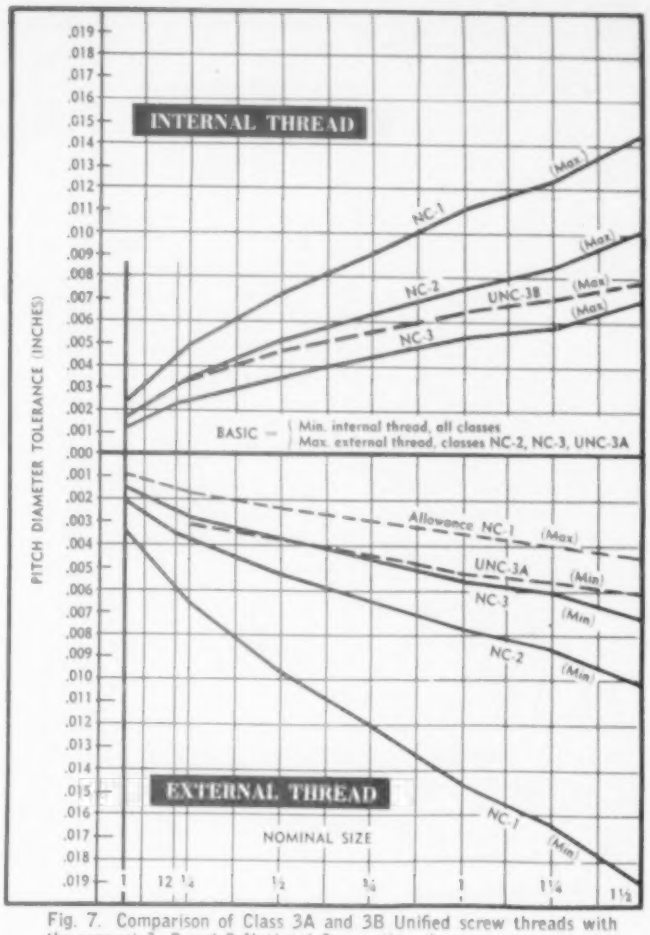

Fig. 7. Comparison of Class 3A and 3B Unified screw threads with the present 1, 2 and 3 National Coarse threads.

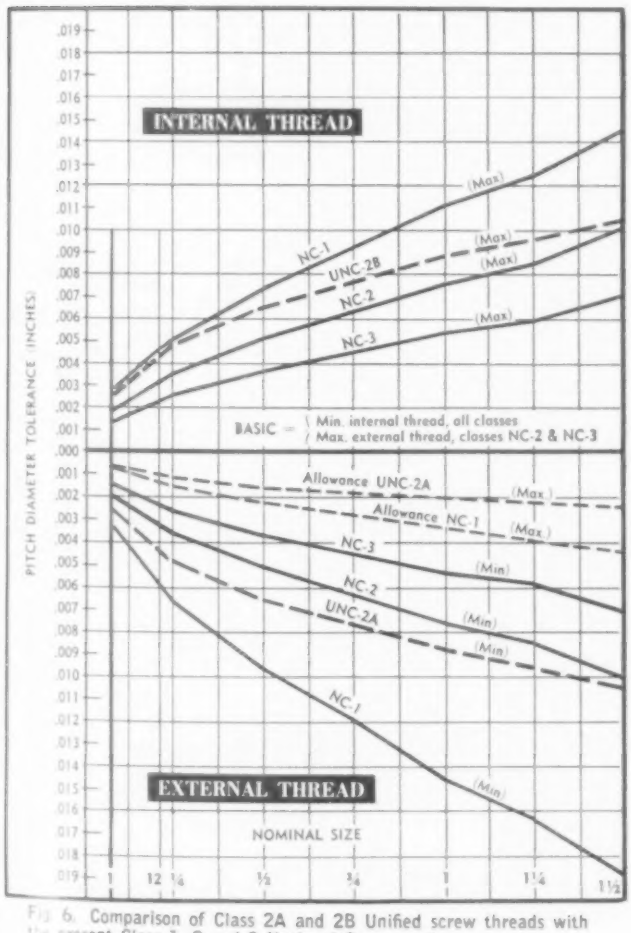

Fig. 6. Comparison of Class 2A and 2B Unified screw threads with the present Class 1, 2 and 3 National Coarse series.

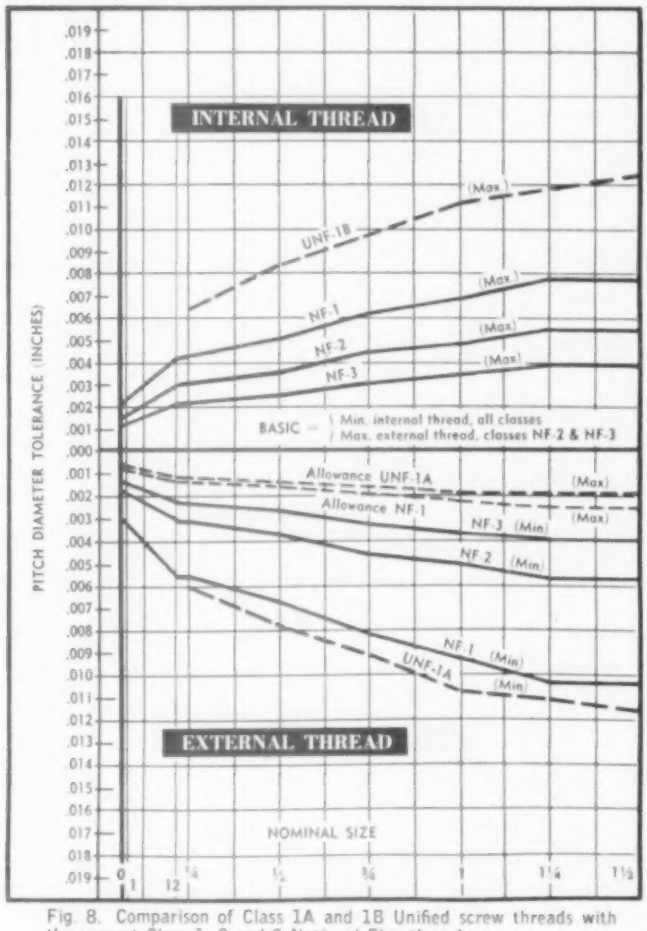

Fig. 8. Comparison of Class 1A and 1B Unified screw threads with the present Class 1, 2 and 3 National Fine threads.

For the Class B holes, the present minimum gages for all classes are correct. New maximum limit gages will give benefit of all full allowable production tolerance. In general the same taps will be used, though in some sizes it may be possible to use commercial ground taps instead of precision ground—this will provide longer tap life. As previously stated, there is no change in the minor diameter, so the same drills and gages can be used. It is to be particularly noted that this is a revision instituted and revised by, and to meet the demands of, the user of the finished product.

The committee is working on a revised specification for gages and gaging. One of the points to be covered is that British products of threaded holes must not be rejected with gages having sharp corners. The British gage may have a rounded crest; likewise our screws should not be rejected by British gages with a round root. The position of this interference is shown in Fig. 2.

With the tolerances provided, there will be no assembly difficulties of parts made to either the British or American practice, because the greatest theoretical interference that can result would not be even a wrench fit.

Implementation of Standards

To minimize any misunderstanding during changeover from the 1935 screw thread standards to the new Unified 2A and 2B tolerances, the Sectional Committee on Standardization and Unification of Screw Threads, B1, (the body responsible for the new American Standard for Unified and American Screw Threads) at its meeting on April 14, 1949, drafted the following release to industry:

"The most significant modification in the Unified and American Screw Thread Standard is the addition of Classes 2A and 2B.

"Class 2A is an external thread classification which provides an allowance or clearance between its maximum metal condition and the minimum metal condition of any class of internal thread into which it assembles. This clearance minimizes galling and seizing in high-cycle wrenching and high temperature applications. It also accommodates plating when required. Class 2A is recognized as standard practice production of screws, bolts, and other threaded fasteners. Class 2B is a realistic approach to the tolerances required in the production of standard nuts.

"Changing to Classes 2A and 2B does not affect strength or interchangeability. Components are mechanically and functionally interchangeable in any combinations of the old and new classes.

"Specification and adoption of these new classes of thread into actual practice will require restraint on the part of the users in order to afford manufacturers opportunity for reduction of present inventories of finished product and working off of current stocks of tools and raw materials.

"To implement changeover to the new classes of thread, users for an indeterminate period should specify the new classes but permit the old classes as optional. Conversely when specifications are not changed, users should accept the new classes as optional.

"Producers and users have agreed that implementation of the new standards should proceed as rapidly as transition can be effected, and that inspection should be governed accordingly. They recommend, however, that for the time being neither the new nor the old classes as they apply to screws, bolts, nuts and similar threaded fasteners, should be mandatory except for specific applications agreed upon by consumer and producer."

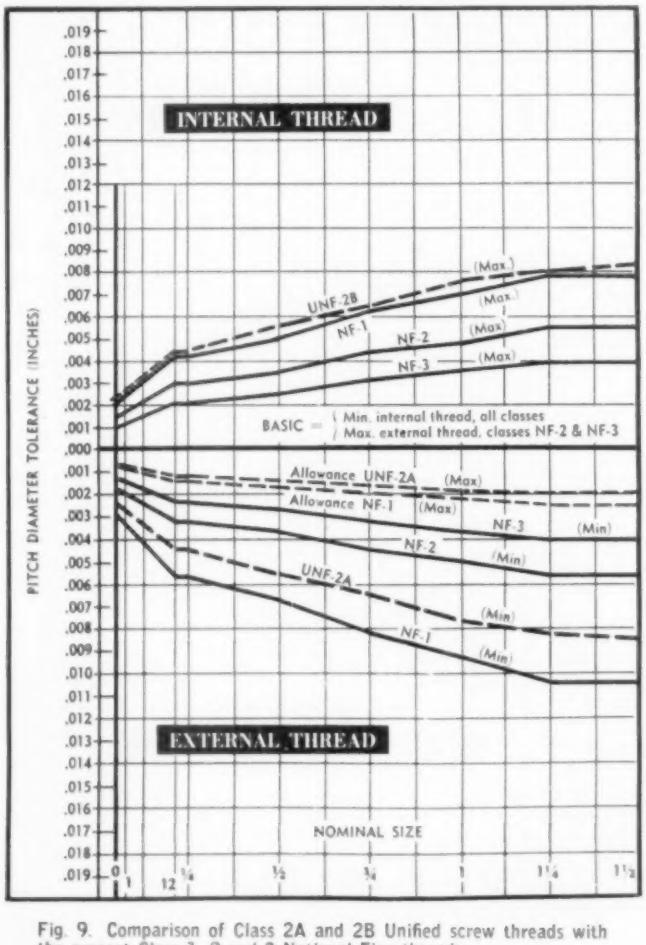

Fig. 9. Comparison of Class 2A and 2B Unified screw threads with the present Class 1, 2 and 3 National Fine threads.

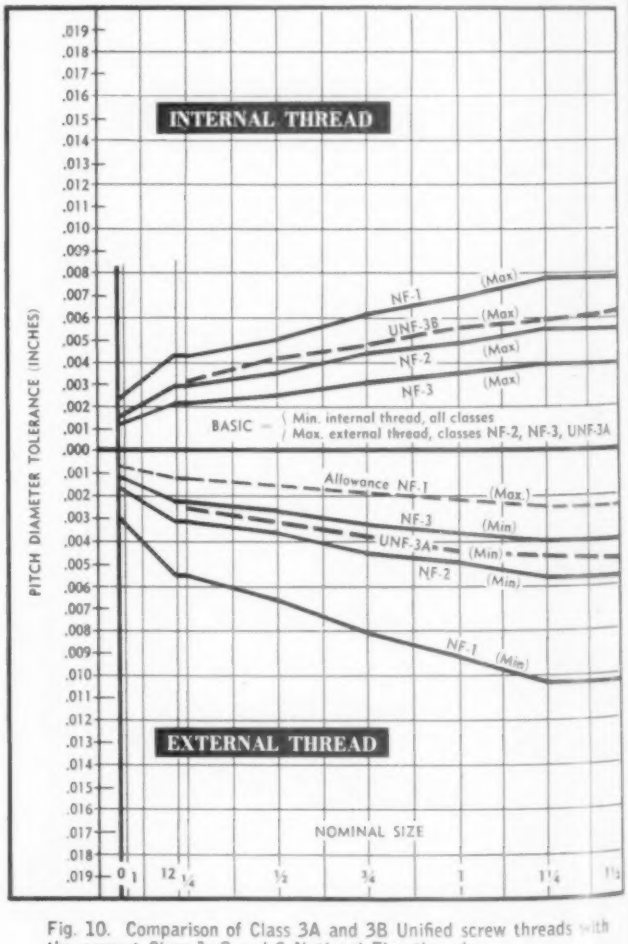

Fig. 10. Comparison of Class 3A and 3B Unified screw threads with the present Class 1, 2 and 3 National Fine threads.

How The Engineering Society of Detroit and Affiliate Groups Organized

Engineering Refresher Courses for State Licensing Examinations

By John J. Ucker

DIRECTOR, MECHANICAL ENGINEERING DEPARTMENT
UNIVERSITY OF DETROIT

IN RECENT YEARS the need for engineering registration and the desire of engineers to be registered have been greatly accelerated. The majority of applicants have found the written examinations a stumbling block and for that reason in 1946 the Engineering Society of Detroit undertook sponsorship of a series of refresher courses to aid engineers in preparing for these tests.

Previously such courses, to recall to mind and reemphasize those principles of engineering fundamentals, engineering law, and ethics, which would be useful in the State examinations, were given only as private projects within engineering firms. Such work, of necessity, covers only a very localized group of engineers. Hence the broad need was not cared for by this means.

In the fall of 1945 Grant Wilcox (your retiring ASTE director), then chairman of the Affiliate Council of the Engineering Society of Detroit, suggested that the Engineering Society of Detroit prepare and present such courses for engineers and architects since it was an ideal coordinating agency for such a project.

The Affiliate Council of the Engineering Society of Detroit is a body composed of two representatives from each of the affiliated societies (35 in all, including the Detroit Chapter of the ASTE). Its function is to bring before the ESD those matters which are of concern to all engineers in the Detroit area and to take to the local chapters, or sections, of various engineering societies information from the ESD.

The ESD board of directors instructed the Affiliate Council to proceed with the project on a self-sustaining basis and offered the use of the Society headquarters' facilities at no charge. The Affiliate Council set up a committee on refresher courses. After considerable investigation this committee decided to limit the course to members of the ESD and its affiliates; to choose a key man to lay out and supervise the courses of instruction; to tentatively set an enrollment fee of $30. The council then appointed subcommittees to proceed with the organization of the instruction and to prepare for registration.

The subcommittee on instruction selected the author to take charge of the courses and, using his experiences with such work, to lay out a program. In cooperation with the executive secretary of the State Board of Registration he set up a tentative plan which provided that the courses for engineers and architects be arranged roughly in accordance with the divisions of the examinations. The study program was divided as follows:

Part I—Fundamentals of Engineering
Part II—Engineering Law, Ethics, Reports Writing, English
Part III—Professional Practice.

When plans were completed for the courses, the number of candidates promised to be so large that the registration fee was lowered to $25. Upon enrolling, they were informed of the experimental nature of the project, and were warned that completion of the course was neither a guarantee of passing the State examinations nor would it influence the Board. The State Board was aware that the courses were being given and approved of the work. It was further pointed out to the class that success or failure of any individual would depend to some extent on careful and serious work, since 15 weekly one-day sessions provided only a short time to cover any phase of engineering or architecture.

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Thus the program shaped up as a course of lectures and illustrative examples on the legal and ethical phases of engineering which were called Part II and a series of lectures with classroom and home problem solutions to illustrate the theory for the first examination which was called Part I. The architects have a special examination for the whole three days. Their preparation was divided into five parts to parallel their examination.

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For the Class B holes, the present minimum gages for all classes are correct. New maximum limit gages will give benefit of all full allowable production tolerance. In general the same taps will be used, though in some sizes it may be possible to use commercial ground taps instead of precision ground—this will provide longer tap life. As previously stated, there is no change in the minor diameter, so the same drills and gages can be used. It is to be particularly noted that this is a revision instituted and revised by, and to meet the demands of, the user of the finished product.

The committee is working on a revised specification for gages and gaging. One of the points to be covered is that British products of threaded holes must not be rejected with gages having sharp corners. The British gage may have a rounded crest; likewise our screws should not be rejected by British gages with a round root. The position of this interference is shown in Fig. 2.

With the tolerances provided, there will be no assembly difficulties of parts made to either the British or American practice, because the greatest theoretical interference that can result would not be even a wrench fit.

Implementation of Standards

To minimize any misunderstanding during changeover from the 1935 screw thread standards to the new Unified 2A and 2B tolerances, the Sectional Committee on Standardization and Unification of Screw Threads, B1, (the body responsible for the new American Standard for Unified and American Screw Threads) at its meeting on April 14, 1949, drafted the following release to industry:

"The most significant modification in the Unified and American Screw Thread Standard is the addition of Classes 2A and 2B.

"Class 2A is an external thread classification which provides an allowance or clearance between its maximum metal condition and the minimum metal condition of any class of internal thread into which it assembles. This clearance minimizes galling and seizing in high-cycle wrenching and high temperature applications. It also accommodates plating when required. Class 2A is recognized as standard practice production of screws, bolts, and other threaded fasteners. Class 2B is a realistic approach to the tolerances required in the production of standard nuts.

"Changing to Classes 2A and 2B does not affect strength or interchangeability. Components are mechanically and functionally interchangeable in any combinations of the old and new classes.

"Specification and adoption of these new classes of thread into actual practice will require restraint on the part of the users in order to afford manufacturers opportunity for reduction of present inventories of finished product and working off of current stocks of tools and raw materials.

"To implement changeover to the new classes of thread, users for an indeterminate period should specify the new classes but permit the old classes as optional. Conversely when specifications are not changed, users should accept the new classes as optional.

"Producers and users have agreed that implementation of the new standards should proceed as rapidly as transition can be effected, and that inspection should be governed accordingly. They recommend, however, that for the time being neither the new nor the old classes as they apply to screws, bolts, nuts and similar threaded fasteners, should be mandatory except for specific applications agreed upon by consumer and producer."

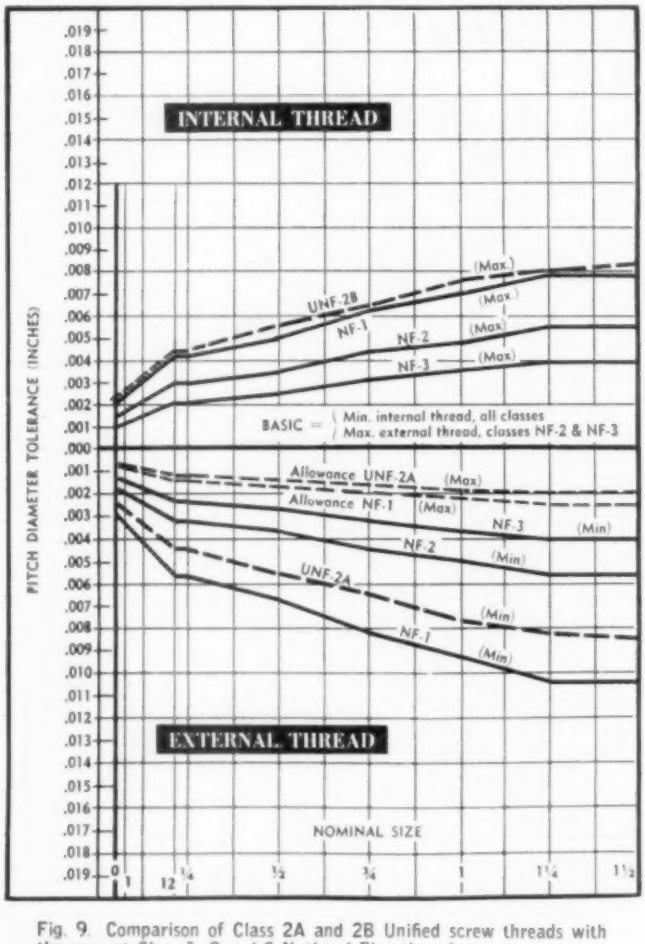

Fig. 9. Comparison of Class 2A and 2B Unified screw threads with the present Class 1, 2 and 3 National Fine threads.

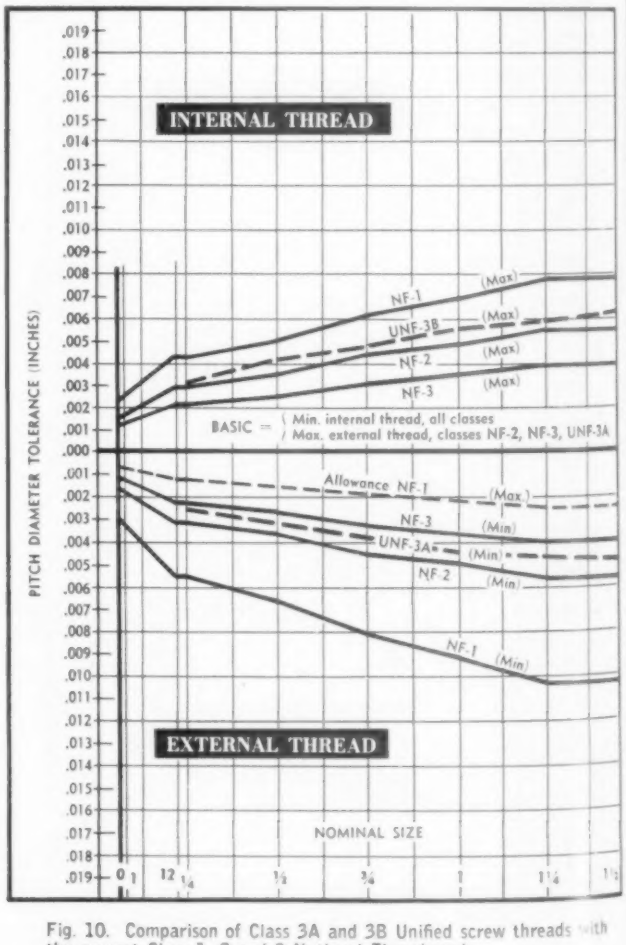

Fig. 10. Comparison of Class 3A and 3B Unified screw threads with the present Class 1, 2 and 3 National Fine threads.

How The Engineering Society of Detroit and Affiliate Groups Organized

Engineering Refresher Courses for State Licensing Examinations

By John J. Ucker

DIRECTOR, MECHANICAL ENGINEERING DEPARTMENT
UNIVERSITY OF DETROIT

IN RECENT YEARS the need for engineering registration and the desire of engineers to be registered have been greatly accelerated. The majority of applicants have found the written examinations a stumbling block and for that reason in 1946 the Engineering Society of Detroit undertook sponsorship of a series of refresher courses to aid engineers in preparing for these tests.

Previously such courses, to recall to mind and reemphasize those principles of engineering fundamentals, engineering law, and ethics, which would be useful in the State examinations, were given only as private projects within engineering firms. Such work, of necessity, covers only a very localized group of engineers. Hence the broad need was not cared for by this means.

In the fall of 1945 Grant Wilcox (your retiring ASTE director), then chairman of the Affiliate Council of the Engineering Society of Detroit, suggested that the Engineering Society of Detroit prepare and present such courses for engineers and architects since it was an ideal coordinating agency for such a project.

The Affiliate Council of the Engineering Society of Detroit is a body composed of two representatives from each of the affiliated societies (35 in all, including the Detroit Chapter of the ASTE). Its function is to bring before the ESD those matters which are of concern to all engineers in the Detroit area and to take to the local chapters, or sections, of various engineering societies information from the ESD.

The ESD board of directors instructed the Affiliate Council to proceed with the project on a self-sustaining basis and offered the use of the Society headquarters' facilities at no charge. The Affiliate Council set up a committee on refresher courses. After considerable investigation this committee decided to limit the course to members of the ESD and its affiliates; to choose a key man to lay out and supervise the courses of instruction; to tentatively set an enrollment fee of $30. The council then appointed subcommittees to proceed with the organization of the instruction and to prepare for registration.

The subcommittee on instruction selected the author to take charge of the courses and, using his experiences with such work, to lay out a program. In cooperation with the executive secretary of the State Board of Registration he set up a tentative plan which provided that the courses for engineers and architects be arranged roughly in accordance with the divisions of the examinations. The study program was divided as follows:

Part I—Fundamentals of Engineering
Part II—Engineering Law, Ethics, Reports Writing, English
Part III—Professional Practice.

When plans were completed for the courses, the number of candidates promised to be so large that the registration fee was lowered to $25. Upon enrolling, they were informed of the experimental nature of the project, and were warned that completion of the course was neither a guarantee of passing the State examinations nor would it influence the Board. The State Board was aware that the courses were being given and approved of the work. It was further pointed out to the class that success or failure of any individual would depend to some extent on careful and serious work, since 15 weekly one-day sessions provided only a short time to cover any phase of engineering or architecture.

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above-mentioned phases of engineering fundamentals thoroughly could get a good grade in the first day's examination. As these subjects were common to all fields, it would be proper to teach these fundamentals to heterogeneous groups and all would benefit equally. It was decided to devote the first ten periods to various parts of mechanics and strength of materials, the next three to hydraulics and the final two class periods of work in the field of specialization. No attempt was made to segregate the various fields during the first 13 periods, but the groups were separated according to specialties for the final classes.

The work in Part II consisted of typical problems and the theory and background for the legal and ethical phases. Ten two-hour sessions divided equally between the two subjects were devoted to this work. Requirements for the teachers in the various sections were established as follows: As the work in engineering fundamentals is so meticulous in detail and must be very carefully presented, it was felt that it would be advisable to have this phase of work taught only by professors of engineering who also were registered professional engineers. Specialists familiar with both engineering and law were selected for Part II and the architectural work was given by men in that field. Registered professional engineers engaged in practice in industry or in consulting practice were considered best qualified to give the specialized work of the last two class periods.

No attempt was made to check on a student's performance. It was felt that these men wanted this work and that it should not be necessary to persuade them to prepare for the examinations. No time was spent giving quizzes. The various instructors made up a series of problems to be solved on every phase of the work, giving more than sufficient material to be worked out to illustrate points covered in class. This work was not graded. Class attendance averaged 85 to 90 percent, with varying people present each time. Not over five percent dropped out of any part of the program.

Instructors were, and still are paid $25 per two hour session for their services. Publicity, printing, postage and other expenses were borne by the Engineering Society of Detroit, and class meetings were held in their conference rooms. The practice of using a key man to head the actual instruction and to plan and administer the program has been found quite effective and is being continued.

All over the country engineers are becoming increasingly aware of engineering licensure laws now in effect in varying degrees in all forty-eight states. For nearly five years your Special Committee on Professional Engineering has been active in bringing to the officers of each chapter information to aid them in assisting their ASTE membership to understand and comply with these laws.

Several chapters have been effective in their work and in the results accomplished. Specific accomplishments have been broadcast to each chapter together with five copies of Past President A. M. Sargent's comprehensive study of licensure laws.

Now comes this story of the organization and conduct of a refresher course to prepare practicing engineers to take and pass their state board examination. Given in Detroit for the past four years this particular course has proven eminently successful in accomplishing its purpose. Actively participated in by the Detroit Chapter, approximately 200 of their members are now Registered Professional Engineers.

Wherever engineering teaching personnel of college level can be procured this same program should be equally successful on a self-sustaining basis for all engineers in the area.

Special Committee on Professional Engineering

The work has now been taught for the fourth time and the number of sessions have been increased to 17, for Part I, and to 12 for Part II. The architectural course was found to be just about right at the original twelve sessions. It is safe to say that a longer program is desirable in Part I, with the additional time being given to the fields of specialization. It might also be desirable to require definite assignments to be turned in by students. About 90 percent of class time is devoted to lectures and the rest to problem illustration. Part I now has an accumulation of approximately 350 problems, all carefully chosen to illustrate important fundamental principles. Their solution helps clarify and fix major points. Part II has been developed into a considerable number of type cases, each illustrating points discussed.

Study Program for Engineers

PART I

Session 1—Composition and resolution of forces. Moments. Equilibrium of forces and moments. Polygon of forces.

Session 2—Determination of stresses in members of statically determinate plans structures with loads at rest. Method of joints. Methods of sections. Funicular polygon.

Session 3—Centroids. Centers of gravity. Moments of inertia. Moments about parallel axes and their translation. Polar moments of inertia. Radius of gyration.

Session 4—Stresses and strains. Modulus of elasticity. Poisson's ratio. Stress and strain diagrams. Yield point. Ultimate strength. Elastic limit. Induced stresses. Factor of safety. Tension. Compression. Torsion. Shear.

Session 5—Shear and moment in beams. Shear and moment diagrams. Relation between moment, shear and deflection. Neutral axis. Section modulus.

Session 6—Design of beams. Cantilever, simple, fixed end, and constant strength beams. Beams of two materials. Various types of loading. Theorem of three moments.

Session 7—Torsion in shafts. Columns. Column formulas.

Session 8—Friction. Newton's laws of motion. Velocity and acceleration. Angular displacement. Angular velocity. Angular acceleration.

Session 9—Kinetics of bodies under uniform rectilinear acceleration; under variable rectilinear acceleration. Uniform and non-uniform rotation of bodies. Instant centers.

Session 10—Work, energy and power.

Session 11—Hydrostatics. Fundamentals of fluid flow. Bernoulli's theorem.

Session 12—Orifices. Nozzles, Tubes. Weirs.

Session 13—Pipe flow. Pipe friction. Reynolds number.

Session 14—Fundamental laws of thermodynamics. Perfect and practical working substances thermal processes. Gas mixtures. Vapors. Tables of thermal processes.

Session 15—Mixtures of gasses and vapors. Heat transmission. Laws of heat transmission. Partial pressures and humidity.

Session 16—Combustion and combustion relationships, orsat analysis. Calorific analysis. Proximate analysis. Boiler efficiency.

Session 17—Fans. Pumps. Compressors. Engines.

PART II

Engineering Law	5 sessions
Ethics	3 sessions
Business Practice	1 session
Economics	1 session
English	1 session
Report Writing	1 session

Study Program for Architects

Structural Design—Concrete	2 sessions
Structural Design—Steel	2 sessions
Electrical Equipment	1 session
Supervision of Construction	1 session
Mechanical Equipment	1 session
Specifications	1 session
Architectural Practice	1 session
Design	3 sessions

Test Results Enable Evaluation of Basic Machining Factors

Computing Torque, Thrust and Horsepower for Counterbores

By G. F. Bush

ECLIPSE COUNTERBORE COMPANY

As a result of a comprehensive series of tests completed recently, basic data required to compute torque, thrust and horsepower for counterbores has been made available. The studies, made at the University of Michigan with the cooperation of the Eclipse Counterbore Company, were designed to show the relationship between torque, thrust and horsepower and the following variable factors:

A. Diameter of the counterbore
B. Diameter of the pilot
C. Number of teeth
D. Feed
E. Speed
F. Material cut

Since it is impractical and unnecessary to test an infinite range of cutters and pilots, it was decided that sufficient data could be obtained from three sizes of cutters: 1, 1¼ and 1½ in. Pilots of ⅜ and ½ in. diameter were used with the 1 in. counterbore. Pilots of ⅜, ½ and 1 in. were used with the 1¼ in. counterbore and pilots of ⅝, ⅞ and 1⅛ in. diameter were used with the larger (1½ in.) counterbore. It was decided also to limit the depth of the counterbored hole to one-fourth the diameter of the cutter, due to excessive chip interference in those combinations where the diameter of the pilot was less than the root diameter of the cutter. In addition, chip interference gave very high readings which were also impossible to correlate with normal readings since there was no exact method of determining what percent of the value was due to the interference.

Slight Negative Rake

All cutters had an axial rake angle of plus 5 deg. and the teeth were ground 1/32 in. ahead of center, giving the effect of a slight negative to the radial rake angle. The peripheral margin was backed off to 1/32 in. and the primary end relief was 8 deg.

A dynamometer with a steel web diaphragm was designed, constructed and calibrated by the university, which had a capacity of 140 lb. ft of torque and 1,000 lb. of thrust with maximum deflections of 0.001 in. Deflections caused by torque and thrust were measured by Pratt and Whitney Electrolimit gages built into the dynamometer (Fig. 1).

A Kearney and Trecker 2K vertical spindle milling machine was used in the tests because of its wide range of speeds and feeds. It was equipped with a 7½ hp. motor which was loaded to 200 percent capacity in some of the test runs. A graphic recording wattmeter recorded the motor horsepower, while torque and thrust were read directly from the meters in the dynamometer.

Bar stock was used wherever practical for the test material. It was purchased in appropriate diameter and cut to 2 in. lengths. The pilot holes were drilled in a turret lathe with a drill having the same nominal diameter as the pilot to be used.

Certain values of speeds and feeds were selected for the tests and these were modified as necessary to give adequate tool life for the test. Table I indicates the speeds and feeds used in the tests on 1020 cold drawn steel using carbide tipped cutters. It should be noted that these values are given for information only and are not to be construed as recommended values.

Duplicate tests were run at each feed and the torque, thrust and motor horsepower were measured. Torque and thrust were plotted against feed (f), diameter of the counterbore (Dc) and diameter of the pilot (Dp) as illustrated in Fig. 5. The wattmeter recording of the motor power was used to compute the power required to remove a cubic inch of metal per minute and to check the torque values given by the dynamometer. A mechanical efficiency of 80 percent was used to determine the horsepower at the cutter.

To derive an equation to fit the experimental data, it

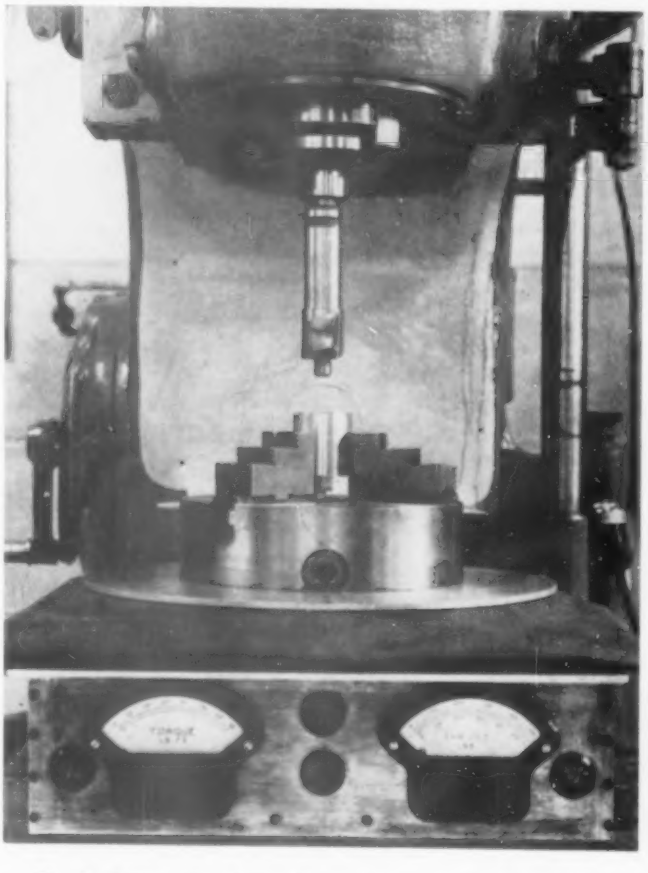
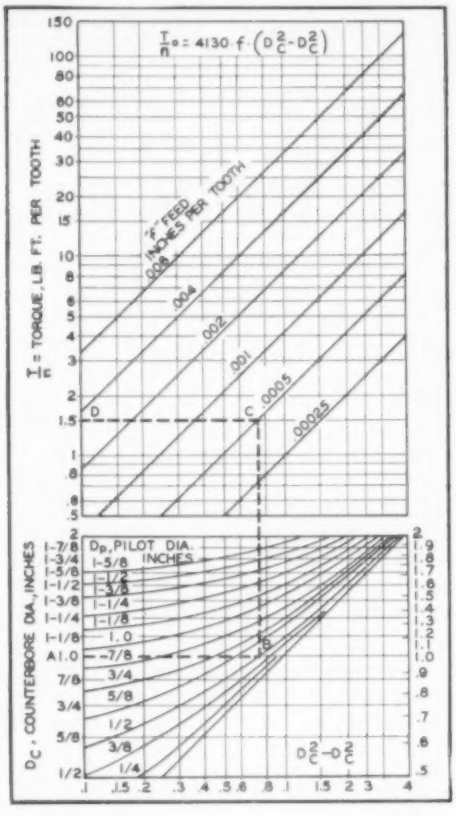
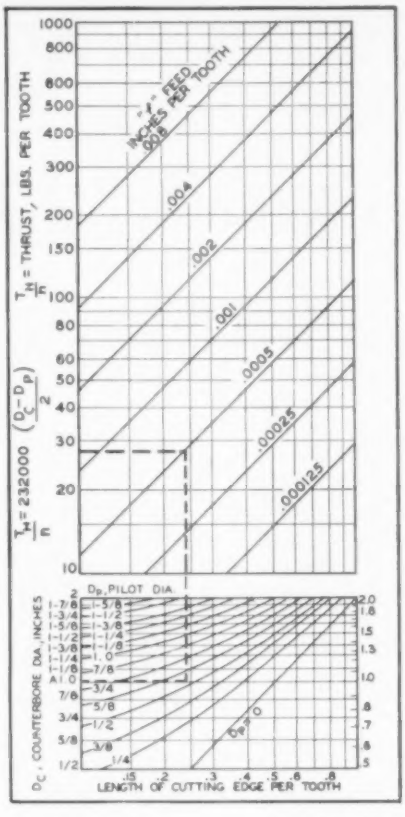


Fig. 1. Torque and thrust dynamometer used for the series of counterbore tests on vertical spindle milling machine.





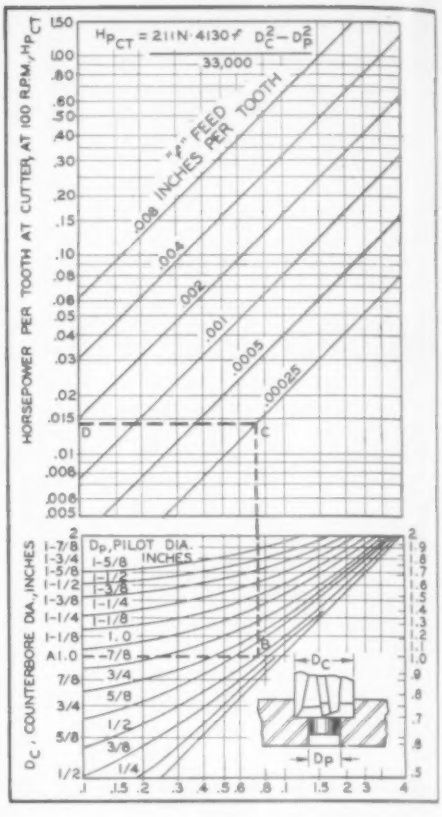


Fig. 2 (left) shows torque for carbide-tipped counterbores; dry cutting SAE 1020 steel, cold drawn 180 Bhn, 187 fpm. Fig. 3 (center) charts the thrust for carbide-tipped counterbores when dry cutting SAE 1020 steel, cold drawn, 180 Bhn, 187 fpm. Fig. 4 (right) gives horsepower at the cutter for carbide-tipped counterbores, dry cutting SAE 1020 cold drawn steel, 180 Bhn, 100 rpm.

was assumed that torque would be affected by the number of teeth (n), feed per tooth (f), the length of cutting edge per tooth $\left(\frac{\text{Dc minus Dp}}{2}\right)$ and the average radius of that cutting edge $\left(\frac{\text{Dc plus Dp}}{4}\right)$. The experimental data were plotted on log-log coordinates and was found to satisfy the general equation —

$$T \text{ (torque) equals } Con^x f^x \left(\frac{(Dc \text{ minus } Pp)\ (Dc \text{ plus } Dp)}{2} \quad \frac{}{4}\right)^y$$

$$\text{equals } Con^x f^x \quad (Dc^2 \text{ minus } Dp^2)\, y$$

$$\text{equals } C\ n^x f^x \quad (Dc^2 \text{ minus } Dp^2)\, y$$

where C is a constant depending upon the material being cut.

Similarly the thrust was assumed to be proportional to the number of teeth "n", the feed tooth "f" and the length of cutting edge $\frac{(\text{Dc minus Dp})}{2}$ and the general equation was

$$\text{Thrust equals } Kon^a f^b \frac{(\text{Dc minus Dp})^c}{2}$$

where K is a constant depending upon the material being cut.

The wattmeter was used to measure the gross power input (hpg) and the tare horsepower (hpt). From these values it is possible to compute the net horsepower (hpn) and the horsepower at the cutter (hpc) —

hpg equals hpt plus $\frac{\text{hpc}}{\text{Mech. eff.}}$ and hpc equals Mech. eff. (hpg minus hpt)

The mechanical efficiency proved to be 80 percent and was practically independent of the speed.

From this computation the unit power, or the horsepower at the cutter per cubic inch of metal removed per minute, may be derived as follows:

$$\frac{\text{HPc}}{\text{Cu. in. per min}} \text{ equals } \frac{\text{hpc}}{(Dc^2 \text{ minus } Dp^2)\ fnN}{4}$$

These values were checked against the values computed from the torque values—

$$\frac{\text{HPc}}{\text{Cu. in. per min.}} \text{ equals } \frac{2\pi\ NTo}{33000\ \text{(cu. in. per min.)}}$$

The average values computed by the two methods checked within 5 percent although individual tests show variations as high as 35 percent. Chip interference caused excessive power increase which was 200 - 300 percent of the normal value. This confirms the findings of practical experience which taught that sufficient force may be generated by chip interference to cause actual failure of the cutter.

By means of the empirical formulas, the test data were converted into graphical form. Figs. 2, 3 and 4 are the graphs for torque, thrust and horsepower respectively. As an illustration on the use of these graphs, assume a 1.0 in. diameter counterbore with a 0.5 in. pilot and a proposed feed of 0.0005 in. per tooth. It is desired to learn how much torque and thrust will be generated by the cutter and how much power will be consumed. To find the torque, refer to Fig. 2. It will be observed that the graph is divided into two parts: the ordinate of the lower part is labeled "Dc, counterbore dia., in."; the ordinate of the upper part is labeled "Torque, lb-ft per tooth".

To find the torque for the 1 in. cutter with the 0.5 in. pilot, start at the ordinate and draw a straight line to the point where it intersects the curve for the ½ in. pilot. From there draw a vertical line parallel to the ordinate. Continue the vertical line until it intersects the "f" feed line marked 0.0005; then draw a line parallel to the abscissa to the point where it intersects the ordinate. The value read at that point, 1.5, is the torque in lb-ft per tooth. If a 4 tooth cutter is used the torque will be 1.5x4 or 6.0 lb-ft.

Experiments proved that torque is affected by the material being cut, as well as by the material from which the counterbore is made. This graph was drawn from data

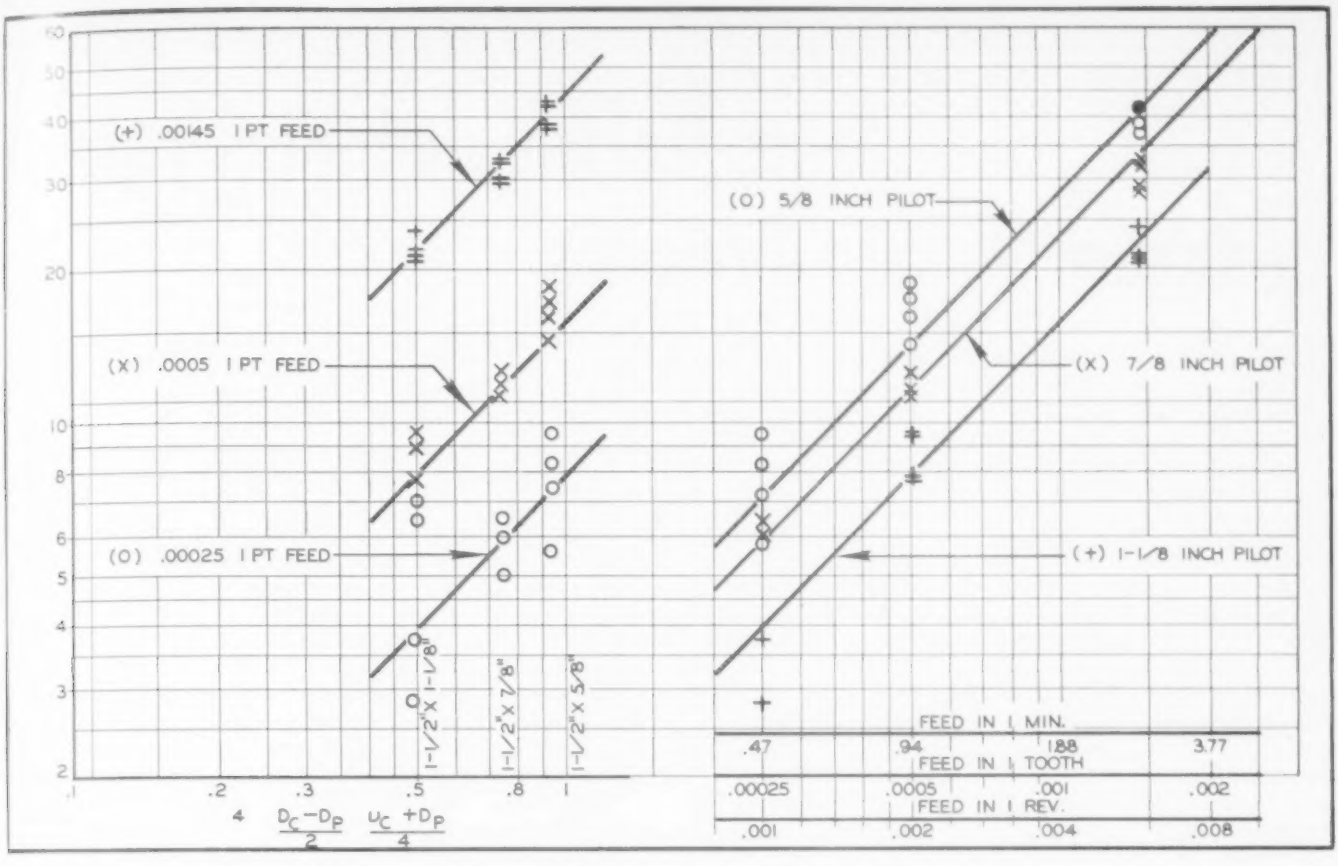


Fig. 5. Shown here are torque and thrust plotted against feed diameter of the counterbores and diameter of the pilot. Used in the tests was a SAE 1020 four-tooth, sintered carbide-tipped, 1½ in. diameter counterbore, dry cutting at 187 fpm.

derived by using a carbide tipped cutter in SAE 1020 steel, cold drawn and with a Brinell hardness of 187. To correct these graphs for other materials such as cast iron or aluminum, or to correct them for high speed steel cutters, correction factors will be found in tables II and III. The torque value determined from the graph should be multiplied by these factors to obtain more representative values. It should be noted also that all values apply only to sharp cutters; for dull cutters a factor of ignorance of 2 is used.

Using these graphs and charts it is now possible to calculate torque, thrust and horsepower for counterbores on a logical basis. Due caution in the use of this information should facilitate the design of jigs and fixtures as well as provide machine tools with adequate power and rigidity. In addition, tool trouble men and tool maintenance men should obtain some value from this study: for example, torque increases directly as the feed (in inches per tooth) increases. Therefore if the feed is doubled the torque is doubled also; thrust and horsepower are affected similarly. Since the number of teeth in the cutter is used as a multiplying factor to determine the total torque (thrust, horsepower) it is obvious that it is advantageous to use as few teeth as conditions will permit.

TABLE I—Speeds & Feeds Used for Test I, Carbide Tipped Cutters on C.R. 1020 Steel

Cutter Dia.-In.	Speeds RPM	Speeds FPM	Feeds	3-Tooth Cutters			4-Tooth Cutters		
1	707	186	ipt	0.000258	0.00052	0.00155	0.00028	0.00056	0.00156
			ipr	0.000774	0.00156	0.00465	0.00112	0.00224	0.00624
			ipm	0.548	1.10	3.28	0.792	1.59	4.66
1¼	577	189	ipt	0.00027	0.00054	0.00158	0.000285	0.00057	0.00167
			ipr	0.00081	0.00162	0.00474	0.00114	0.00228	0.00668
			ipm	0.471	0.935	2.73	0.658	1.32	3.87
1½	471	185	ipt	0.000236	0.00047	0.0016	0.00025	0.00050	0.00145
			ipr	0.000708	0.0014	0.0048	0.0010	0.0020	0.0058
			ipm	0.332	0.658	2.27	0.471	0.935	2.73

It will be observed that speed is not a factor in the equations for either torque or thrust. Therefore these two values are independent of speed and consequently the most economical speed is the highest speed possible consistent with the available power and adequate tool life.

During the course of the test runs, it was observed that there was a relationship between the fit of the pilot in the pilot hole and the tendency of the cutter to chatter. Pilots which were 0.009 in. smaller than the pilot hole in which they guided caused some of the cutters to chatter. When these pilots were replaced by standard pilots which were only 0.004 in. smaller than the pilot hole, the chatter was eliminated. On the other hand, it is known that when too little clearance exists between the pilot and the hole, there is a tendency for the pilot to gall and seize. Very often this chips the cutting edges adjacent to the pilot and in severe cases pilot seizure has caused the cutter to break. In the light of these findings, the present manufacturers' practice is a happy medium with neither too much nor too little clearance for the usual applications.

TABLE II—Factors to Correct Graphs for Various Materials

Material Cut	BHN	Torque Factor	Thrust Factor	Horsepower Factor
1020 steel, cold rolled	180	1.0	1.0	1.0
6150 steel, hot rolled	195	1.3	1.8	1.3
6150 steel, heat treated	241	2.1	2.1	2.1
Tool steel, 1%C., annealed	156	1.9	3.0	1.9
Cast iron 40,000 psi	210	0.85	0.7	0.85
Monel metal	207	1.9	1.4	1.9
Phosphor bronze	156	0.76	0.82	0.76
Leaded brass	124	0.38	0.27	0.38
Aluminum alloy 24st	154	0.54	0.82	0.54
Aluminum, soft 2S	36	1.4	2.7	1.4
Magnesium, cast H alloy	63	0.25	0.27	0.25

TABLE III—Factors to Correct Graphs for H. S. S. Cutters

Material Cut	BHN	Cutting Fluid	Torque Factor	Thrust Factor	Horsepower Factor
1020 Steel, cold rolled	180	16:1 Emulsion	0.85	0.89	0.85
6150 Steel, hot rolled	195	16:1 Emulsion	1.3	1.2	1.3
Cast Iron, 40,000 psi	210	dry	0.73	0.79	0.73

Seam Welding and Miscellaneous Resistance Welding Processes

By E. J. Del Vecchio

SWIFT ELECTRIC WELDER CO.

IN PART I of this series, the principles of spot welding were outlined. A seam weld is essentially a row of spot welds usually made with a pair of rotating electrodes of welding wheels. If the spots are close enough to overlap, it is a roller seam weld, but if not, it is a roller spot weld (see Fig. 1). By adjusting the controls, any desired spot spacing may be obtained.

Seam welders are controlled exclusively by electronic means. Except for very fast work, welding current is fed to the welding wheels in pulsations repeated for the duration of the weld. The duration of each pulsation and time interval between pulsations is called the weld interval. Since there are 3600 cycles per minute in a standard 60 cycle a-c system, the weld interval divided into 3600 equals the number of spots per minute, which, in turn divided into the welding speed, determines the spot spacing (see Table I). It is obvious that, within limits, the thicker the stock, the larger each spot will be to produce sound welds, consequently the fewer the spots per inch required to produce an overlapping gas-tight weld.

On thin gages, the current may be passed into the weld continuously without pulsations, and the welding speed increased two to four times.

The same types of joint are used for seam welding as with spot welding, and the same considerations of lap width and electrode clearance are necessary. Table II gives minimum recommended lap widths for various gages of stock.

The manufacture of cylindrical containers constitutes one of the principal applications of seam welding. This consists of a shell or body containing a longitudinal seam, Fig. 2. The next operation is to weld in a flanged head, Fig. 3. An out-turned flange is shown at *A*, and an in-turned flange at *B*. The out-turned flange is much preferred from a welding standpoint, because the length of the shell is immaterial, whereas with the in-turned flange, the lower welding wheel must go completely through the length of the shell, resulting in a deep-throat-depth machine with greater electrical losses and more mechanical deflection of the lower arm.

Long seams can be welded by welding half the length, turning end for end and completing the weld from the other end. Where the shells are large and the welds long, as with hot water heaters, the lower welding wheel is replaced by an anvil supported at each end, with two wheels above, separated by half the length of the weld, and making a series weld.

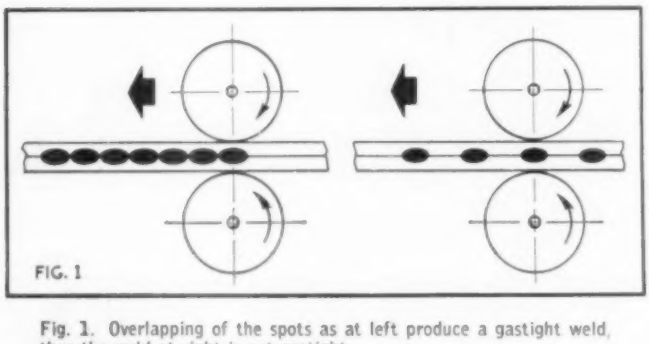


Fig. 1. Overlapping of the spots as at left produce a gastight weld, thus the weld at right is not gastight.

One problem in seam welding heads into seam welded shells results from the lap in the longitudinal weld. This is shown in Fig. 4. There is a space "X" at the lap between the shell and the head which will not be welded. This can be overcome by reducing the lap at this point by notching, then coining the double thickness to an essentially single thickness. Sometimes this can be accomplished by completely notching out the lap and eliminating the coining operation. This, however, is less reliable. Another method is to arc weld this space.

Practically all seam welded jobs must be pre-spot-tack welded, or welded in fixtures, the method to be employed depending on the specific job and production requirements.

A "mash" seam weld is one in which the overlap is approximately one and one half times the stock thickness. With this type of lap, the double thickness is mashed down to one and one quarter times or less the single stock thickness. While this type of weld is harder to control, it does eliminate the overlap gap mentioned above.

Seam Welder Types

Standard seam welding machines are relatively simple and are quite similar to press type spot and projection welders with motor driven roller electrodes. They are of two general types, longitudinal—with the plane of the wheels parallel to the throat of the machine—and circular—with the plane of the wheels at right angles to the throat. In addition, universal machines have their wheels operate in either position. With this type, the upper wheel and head swivels to either position 90 deg. apart, while interchangeable lower arms and wheels are used.

The wheels are driven through suitable gear reduction by an electric motor. Two types of drive are employed: knurl or friction roll, and gear. Either upper or lower wheel or both may be knurl or friction roll driven, but it is difficult to apply a gear drive to both.

Generally speaking, the knurl or friction roll drive is preferred wherever possible, because the wheel face or width in contact with the work is kept constant, also the peripheral speed, consequently welding speed and spots per inch are constant, regardless of wheel wear or diameter. The knurl and friction roll are alike except that the knurl roll not only drives the welding wheel, but continuously knurls its welding face. The advantage of this is two-fold. First, it provides greater traction, and secondly, it continuously breaks up the pick-up from coated stock, such as terne, tin or zinc plated stock. Wherever practicable, both wheels should be driven. Unknurled or friction rolls are used on clean unplated stock and where marking must be held to a minimum. Gear drives are used where dictated by the job—particularly where clearances are too small to permit the knurl drive.

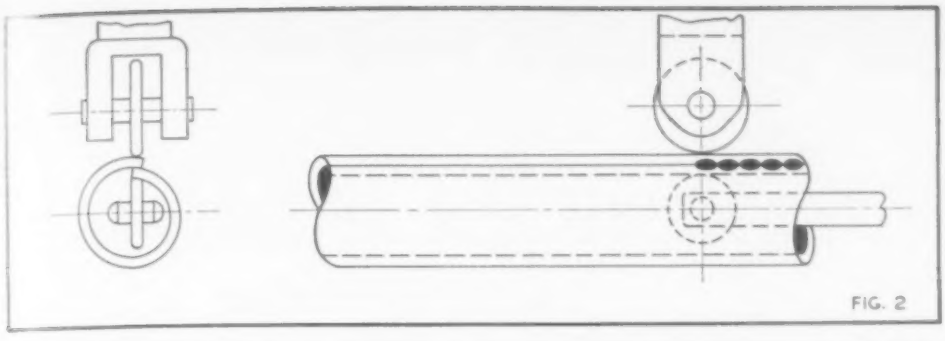


FIG. 2

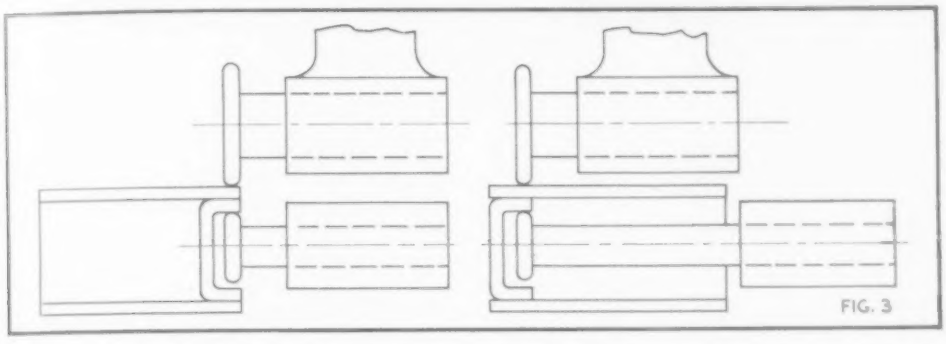


FIG. 3

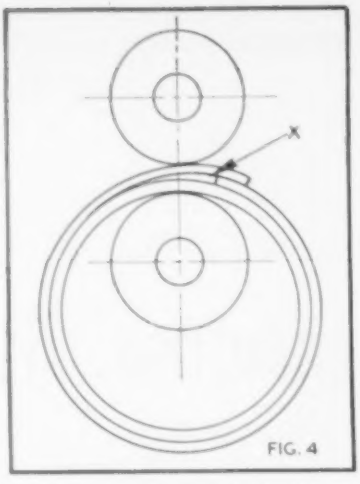


FIG. 4

Fig. 2 illustrates a longitudinal weld on a cylindrical container. Fig. 3 shows that the design at left, using an out-turned flange, makes welding easier than the in-turned flange at right. Fig. 4 presents the condition resulting from welding a circular seam over a previously welded longitudinal joint.

Warpage and distortion are very apt to occur in seam welds and must be carefully guarded against. The most effective preventative is the abundant use of cooling water. Abundant sprays or streams of water should be directed on both sides of the work as close to the weld as possible, particularly immediately following the weld. Wherever possible, for best results, the weld should be made completely under water.

Series seam welds are made in much the same manner as series spot welds. Multiple series seam welds are commonly employed in the fabrication of refrigerator evaporators, liners and other products. The lower arm and wheel may be replaced by an anvil and fixture over which component parts are clamped in place and welded. The upper wheel may travel with the fixture stationary, or it may be stationary, but idling with the fixture moved by screw, rack and pinion or hydraulic cylinder.

Testing Seam Welds

A seam welded joint is estimated at 80 percent to 90 percent efficient. As the weld progresses, the wheel burrows slightly into the work due to the pressure applied on the wheel. While this furrough can be minimized, it cannot be completely eliminated. The weld will invariably fail at the edge of the furrough.

As in other types of welds, it usually is not practicable to test each weld. Specimens may be periodically tensile tested, "peel" tested, or small samples welded completely around and blown up hydrostatically.

Containers, such as automotive gas tanks, may be submerged in water and a low air pressure of five to fifteen pounds applied and observed for bubbles.

About the same rules for stock preparation apply to seam welding as for spot welding. The stock must be clean and free from scale and rust. Otherwise, the welds will be inconsistent, weak and unsightly, and in extreme cases, blow holes will result. If scaly stock must be used, the welding edges should be cleaned by polishing or other suitable means.

All materials that can be spot welded can be seam welded, though welding speeds vary over wide limits. Thin gages (16 gage and less) of mild steel can be welded in continuous seams without pulsations at speeds of 30 to 60 fpm and even faster. Since the shortest weld interval possible on 60 cyclepower is 2 cycles (one on and one off), it follows from Table I that the fastest gas tight seam possible with pulsations is 120 inches per minute, decreasing to 45 inches per minute for 11 gage. While this can be increased some by using more power and shortening the weld interval, the surface marking increases. Stainless steel can be welded at slightly higher speeds because the weld interval is less than for common steel.

Aluminum is seam welded at about one half the speed as the same gage in steel, due to a required longer weld interval time.

Steel with carbon contents of 0.25 percent or over must be carefully considered before attempting to seam weld because it cannot be annealed or given post-heat treatment in the machine, nor is it usually practical to heat the welded assembly later.

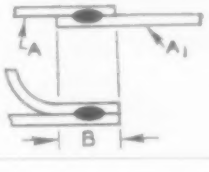
A very important application of resistance welding equipment is resistance brazing. This is usually accomplished on standard spot or projection welders with controls especially adapted for the service. Two types of brazing operations constitute the bulk of such applications. One of these consists of brazing electrical contact points to armatures. These contact points are usually made with a self-

(Continued on page 31)

TABLE I—Relation between weld interval, welding speed and spot spacing. These values are typical for low carbon steel in the gages listed.

Gage	Ins.	Weld Interval Cycles	Weld Speed In./Min.	Spots per Inch
32	0.010	3	80	15
22	0.031	5	72	10
20	0.037	6	67	9
18	0.050	7	65	8
16	0.062	8	63	7
14	0.078	11	55	6
12	0.109	15	48	5
11	0.125	18	45	4.5

TABLE II—Minimum recommended lap widths for various stock thicknesses. If the two pieces A and A_1 are of unequal thickness, the thin piece prevails.



A-A_1	B
0.010	3/8
0.031	1/2
0.037	1/2
0.050	9/16
0.062	5/8
0.078	11/16
0.094	3/4
0.109	13/16
0.125	7/8

Hydraulic Controls and Applications Classified for Optimum Results

Components and Applications of Industrial Hydraulic Systems

By A. G. Winchester
GEROTOR MAY CORPORATION

IN THIS STUDY of the components of industrial hydraulic circuits and of the applications of hydraulic circuits in industry, particular attention will be paid to the characteristics and uses of hydraulic cylinders, valves, pumps, motors and auxiliary equipment.

Of primary consideration in any discussion of hydraulic equipment, the hydraulic cylinder is in essence a device which transforms hydraulic energy into mechanical energy of linear type. Design of the cylinder falls into a number of classifications, including single acting, double acting, double acting provided with 2:1 area relationship, and double acting with a double rod extension.

The single acting type cylinders are generally used on applications which require a vertical motion and where the load to be raised has sufficient mass to retract the cylinder without the help of fluid force. These applications are encountered in such hydraulic lifts as elevators and single-acting hydraulic presses. Frequently single-acting cylinders are used where large forces are required but yet the direction of load will not retract the cylinder, and it is necessary to incorporate pull-back cylinders in order to retract the single-acting main cylinder along with the connected load. Such an arrangement is encountered in large hydraulic presses providing for capacities of 100 tons or more.

Cylinders, Double Acting

Double-acting hydraulic cylinders provided with standard rod sizes are commonly used for applications requiring work to be done on either the extending or retracting strokes. In these cases, assuming a constant volume of oil being delivered to the cylinder, the extending stroke is slower than the retracting stroke, because of the area occupied by the rod on that end of the cylinder. Since it is sometimes desirable to have uniform extending and retracting strokes, cylinders with double rod extensions are provided so that a uniform area may be had on both ends of the cylinder.

Another method of accomplishing uniform rates of speed in both directions is to use a cylinder which employs a rod of such a diameter as would provide an area on the rod end of the cylinder equal to one-half the area of the blind end. During the extending stroke of the cylinder the valving should permit the oil being pumped to be connected to the blind end of the cylinder along with the oil coming from the rod end. During the retracting stroke of the cylinder, the flow from the pump would be connected to the rod end of the cylinder only and the blind end would be connected directly to the oil reservoir.

Cylinders incorporating the 2:1 area relationship are also used to provide retracting speeds twice as fast as the extending stroke without the higher rates of discharge from the pump unit during the retracting cycle which would be necessary on cylinders employing standard rod sizes.

Typical mounting arrangements for hydraulic cylinders include rabbet mounting on the rod end, foot mounting, center line mounting, trunnion mounting, clevis mounting, flange mounting on the rod end, and flange mounting on the blind end. Combinations of these mountings can be readily had and standard or 2:1 rod sizes are available in most mounting styles with the exception of double rod extensions, which cannot be provided in the case of clevis and blind-end flange mountings.

Cylinders can be provided with cushioning on either one or both ends, and this is particularly desirable if the velocities and inertia of connected loads are high. This is accomplished by building into the cylinder a means of restricting the exhaust oil during the last increment of stroke of the piston rod.

Valves, Hydraulic

Hydraulic valves fall into two primary classifications: (a) the hydraulically unbalanced types such as simple gate, globe, relief valves or a compound valve such as a relay type relief valve; (b) the hydraulically balanced types such as directional control valves.

Hydraulic valves can be further classified as simple, compound, or directional, according to their methods of operation.

A simple valve requires only a single internal motion for its operation. For example, liquid acting on one side of the valve against the resistance of gravity or a spring or the valve is raised manually by turning a screw so that a passage for the liquid is opened. Some typical simple valves include gate, globe, check, and relief valves.

A compound valve involves a combination of internal motions for its operation, such as in a relay-type relief valve or a pressure reducing valve.

Directional valves are used to control the direction of flow of liquids along two or more paths. They are manufactured in many sizes and may be operated hydraulically by the differences of forces set up on opposite sides of the moving parts; by hand; by mechanical means or by electric power as, for example, solenoid operated type valves. Frequently referred to as four-way valves, directional valves are manufactured with various spool designs which provide, for example, open center blocked cylinder ports in the neutral position, or one cylinder port blocked while the pump port and the remaining cylinder port are connected to the exhaust in the neutral position. The end use, however, of all the directional valves and their arrangements for actuating is the control of direction of various motions in a hydraulic system.

Adapted from a paper delivered before the Baltimore Chapter 13, ASTE.

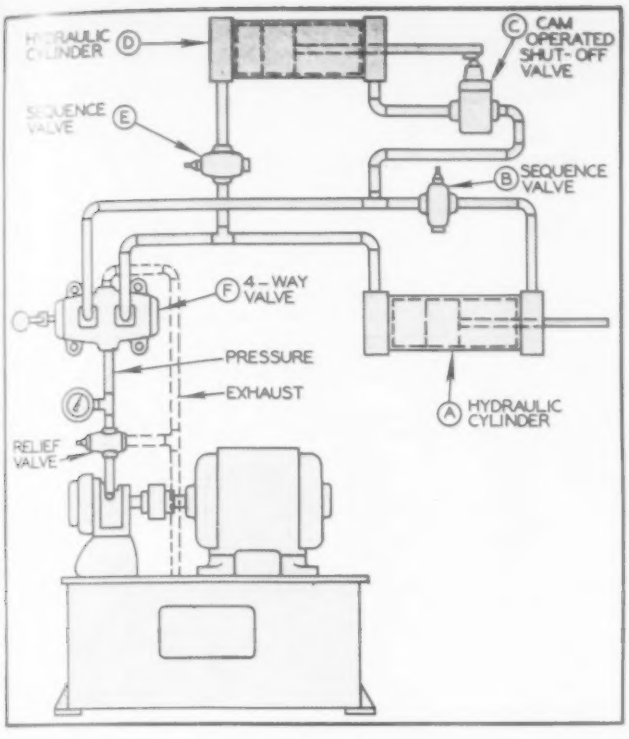


Fig. 1. Shown here is a hydraulic system designed to manually control a two-cylinder set-up which provides for both clamping and cut-off operations.

Pumps, Hydraulic

Hydraulic pumps, which transform mechanical energy into hydraulic energy, can be classified into the centrifugal and the positive displacement types. A positive displacement pump will displace a given amount of fluid per degree of shaft movement.

Positive displacement pumps in general have been narrowed down to the following types as used for industrial hydraulic applications: gear, vane, and piston—either radial or axial type. It is preferred here to break down this grouping into two specific types: the constant displacement type regardless of whether it happens to be gear, vane, or piston; and the variable displacement type which is generally the piston type pump incorporating a means of externally varying the stroke of the pistons. In the case of the variable displacement type pumps, the strokes frequently can be varied from some maximum down to and including zero. Further, variable displacement pumps are available which, assuming a unit direction of drive such as by the electric motor to the input shaft of the pump, will displace oil in one direction of flow from a maximum down to a minimum, then pass through what is known as zero displacement or no stroke. Finally, by further external operation of the stroking means, the direction of flow is reversed and displacement occurs up to the original maximum in the opposite direction of flow.

The rotary type pumps are self-priming and capable of producing an extremely high vacuum. They will handle liquids having a wide range of viscosity, but the liquids must have good lubricating qualities since these pumps depend upon the liquid pumped for their lubrication. For this reason it is important that the liquid being pumped be kept absolutely clean and that the supply lines to these pumps be provided with a filter to guard against the entry of foreign matter.

The volumetric efficiency, or the relationship of the actual delivery to the theoretical delivery, of this class of pump decreases with pressure and increases with viscosity. The overall efficiency, which is the relationship of the input horsepower to the hydraulic output horsepower, increases sharply with pressure up to a point which is approximately one-half or three-quarters of the maximum rated pressure and then drops slightly as pressure is increased to the maximum rating. In general the volumetric efficiency will increase with the increase in pump size and will range from 75 percent at 1000 psi for pumps of ½ gpm rating to about 95 per cent for ratings of 40 gpm. For this same range of pump sizes, the overall efficiency will vary from about 45 to about 90 percent.

Motors, hydraulic

A hydraulic motor, which transforms hydraulic energy into mechanical energy in the form of shaft rotation, is really a pump used in reverse, since it is driven by liquid supplied by another pump. Fluid motors in general are considerably smaller in size than an electric motor of similar horsepower rating, and the low inertia of their rotating elements as compared to electric motors permits very rapid changes of speed and direction of rotation. The relation between the rated pump flow and displacement of the fluid motor determines the maximum available speed obtainable. The speed of the hydraulic motor can be readily varied through a speed range from some maximum to a desired minimum with the use of a volume control valve.

Constant-displacement type fluid motors have reasonably flat torque and variable horsepower characteristics, the power output being proportional to shaft speed as long as the operating pressure remains constant.

Fluid motors can be stalled under load without damage, operated in explosive and corrosive atmospheres, and installed in small confined spaces.

Accumulators

Due to its virtual incompressibility, fluid cannot be stored as energy in an ordinary vessel or chamber. In other words, if a chamber is totally filled with a fluid under any pressure, say 5000 psi, the loss of as little as 2 percent of the fluid would immediately drop this pressure to zero.

Specifically, a hydraulic accumulator is a mechanism in which the potential energy of a fluid can be stored against some dynamic force to do useful work as called upon by the hydraulic circuit in which it is used.

There are various types of accumulators in use, including the gravity type, the spring load type, the air-or nitrogen-loaded type without separator, the air-or nitrogen loaded-piston type, and the diaphragm type.

Before proceeding with a description of typical hydraulic applications, a number of advantages derived from hydraulics are presented for consideration:

(a) Finger-tip control of immense forces and power with equipment which is at the same time rugged and durable.

(b) Ability to apply forces remote from the prime mover.

(c) Ability to control equipment at various control stations adjacent to or remote from the equipment.

(d) Ability to readily inter-lock or sequence functions.

(e) Ability to produce fast, smooth reversal of motion.

(f) Ability to rapidly change rates of motion, and different rates of motions in different directions.

(g) Ability to stall under load for indefinite periods without damage to equipment.

(h) The equipment is self-lubricating.

(i) For the same power rating, hydraulic equipment is generally smaller and lighter than other types of equipment.

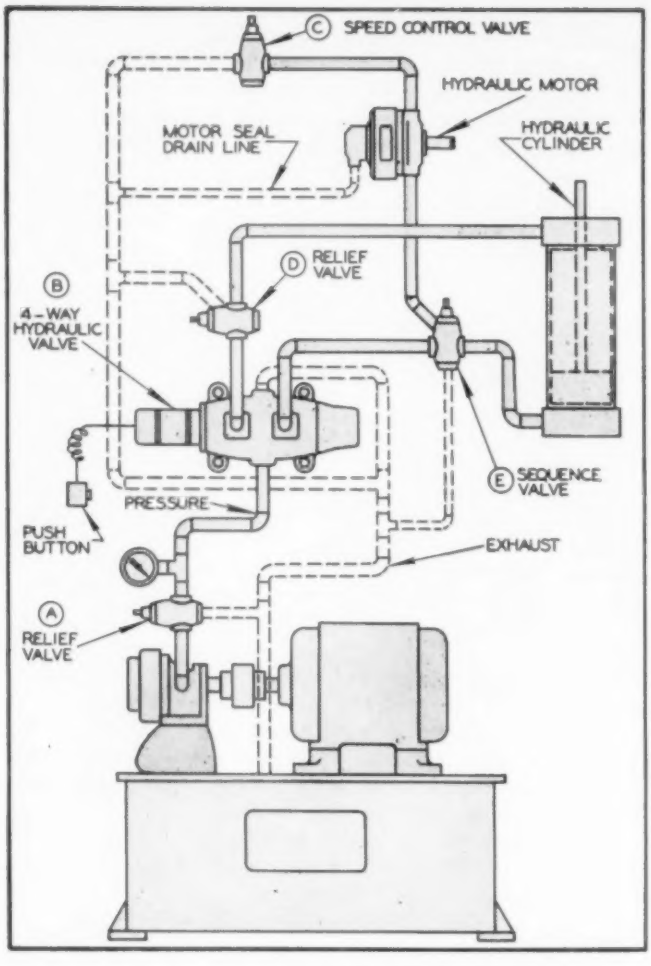


Fig. 2. Semi-automatic electric conrtol having the sequence feature of a cylinder as well as fluid motor set-up. The cylinder is provided for clamping of the work, and the fluid motor provides for manual feed for a turning operation.

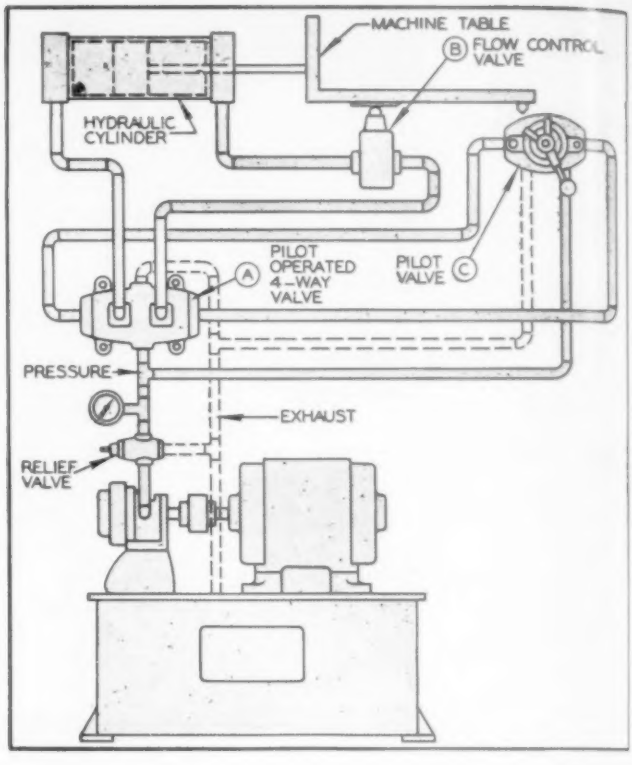


Fig. 3. Above is a pilot-operated control single pump which provides for continuous reciprocation of the cylinder rod.

Industrial Applications of Hydraulics

The various circuit diagrams shown here are provided to show methods of incorporating hydraulic devices into circuits, and do not necessarily indicate the most desirable method of accomplishing the application.

Illustrated in Fig. 1 is a hydraulic system for the manual control of a two cylinder set-up which provides for clamping and cut-off operations. We can assume that the cylinder at *D* is actuating a power-driven rotating saw. The cycle is started by moving the handle of the four-way control valve *F* to the "in" position, directing oil to the blind end port of hydraulic cylinder *A* and moving the piston outward. When cylinder *A* outward stroke is completed, pressure will then build up in the supply line, resulting in the actuation of sequence valve *E* which then permits the flow of oil into the blind end of hydraulic cylinder *D*. Hydraulic cylinder *D* will extend at its rated speed until cam operated valve stem *C* is depressed. Continued rate of outward motion of hydraulic cylinder *D* is manually determined by the setting of flow adjustment screw of valve *C*. Cycle is reversed by moving the handle of the four-way hydraulic valve *F* to its full "out" position, causing cylinder *D* will to retract. When cylinder *D* has completely retracted, cylinder *A* will then retract as a result of sequence valve *B*.

Fig. 2 illustrates a semi-automatic electric control with the sequence feature of a cylinder and fluid motor set-up. A cylinder is provided for clamping of the work as well as a fluid motor to provide for a turning operation manual feed. Here the cycle is started by energizing solenoid coil of the four-way hydraulic valve *B*. Oil is directed from the pump through hydraulic valve *B* and into the blind end of the hydraulic cylinder, and after the cylinder has fully extended or closed clamping device, sequence valve *E* will permit the flow of oil to the hydraulic motor, resulting in its rotation. Shaft speed of the hydraulic motor may be varied by the manual adjustment of speed control valve *C*. The circuit is reversed by interrupting the current applied to the solenoid of the four-way control valve *B*, which then allows the spring to return the valve plunger and reverses the circuit. Oil will flow from the pump to the rod end of the hydraulic cylinder, causing the cylinder to retract. The relief valve *D* is provided to exhaust the pump at a pressure lower than the main valve *A* setting, after the cylinder has completely retracted. The hydraulic motor will stop running the moment the current is interrupted.

Remote Pilot-Operated Pumps

A remote pilot-operated control single pump, providing for continuous reciprocating of the cylinder rod, is shown in Fig. 3. The operation of the cylinder in this circuit is effected by starting the electric motor, which results in continuous reciprocation of the cylinder rod during the period the pump is being driven by the electric motor. In one position of the pilot operated four-way valve *A*, the oil is directed from the pump to the blind end of the hydraulic cylinder, and the cylinder extends at its rated speed. The machine table advances to a position which causes the cam of flow control valve *B* to depress. At this time the forward speed of the cylinder is effected by the setting of the flow adjusting screw of valve *B*. In the other position of valve *A*, oil is directed from the pump to the rod end of the hydraulic cylinder, resulting in its retracting at full rated speed and in this direction of cylinder movement valve *B* has no effect on the speed of the cylinder. The pilot valve *C* provides for the remote hydraulic operation of the main four-way valve *A*. The forward, or return stroke of the cylinder may be manually interrupted at any time by the operator reversing the handle position of pilot valve *C*.

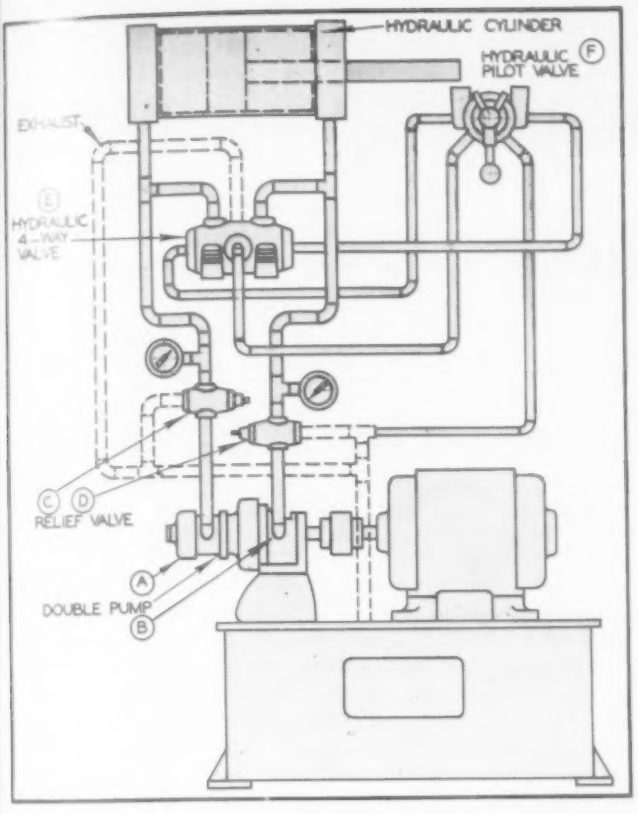


Fig. 4. Another remote pilot-operated system, featuring a double pump design, is shown above. Feature here is that double pump design permits two different rates of flow.

Fig. 4 presents a remote pilot operated control double pump which provides for continuous reciprocation of the cylinder rod. The operation of the cylinder in this circuit is effected by starting the electric motor, resulting in the continuous reciprocating of the cylinder rod during the period the pump is being driven by the electric motor. In this circuit a double pump is used which permits two different rates of flow. Pump *A*, the smaller of the two pumps, is connected directly to the blind end of the cylinder with a branch line running to one of the cylinder ports of the hydraulic control valve *E*. Pump *B*, the larger volume pump, is connected directly to the rod end of the hydraulic cylinder with a branch line connected to the remaining cylinder port of the four-way valve. Pilot valve *F* is actuated by dogs connected to the machine table which is actuated by the rod of the hydraulic cylinder. The valve permits remote reversing of the position of the four-way valve plunger by directing fluid first to one end and then to the other of the four-way control valve. The reversing of valve *E* will result in first blocking one cylinder port

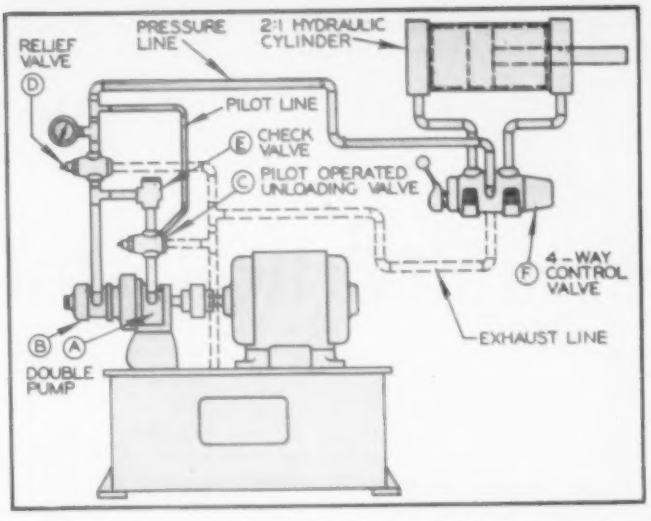


Fig. 5. Construction above is designed for applications where rapid speed and low pressure are required for the major part of the stroke, with a high pressure needed for the final portion. The high-low double pump is manually operated and provides fluid energy to a 2:1 type cylinder.

and then the other, causing the cylinder to reciprocate at the rates determined by the selected capacities of the double pump. The relief valves *C* and *D* provide for limiting the maximum pressure imposed on the equipment in the event of failure of the reversing mechanism. Speed control of either the retracting or extending stroke of the hydraulic cylinder may be had by providing a suitable flow control valve for metering the unused oil. The forward or return stroke of the cylinder may be manually interrupted at any time by the operator's reversing the handle position of pilot valve *F*.

The manually operated double pump set-up shown in Fig. 5 is arranged for high-low pressure service and provides fluid energy to a 2:1 type cylinder. The circuit illustrates the use of the high-low pump unit in connection with a press application where rapid speed and low pressures are required for the major portion of the stroke and where high pressures are required for the "squeeze" portion of the stroke. The output of both the low pressure high volume pump *A* and the high pressure small volume pump *B* is directed to the hydraulic cylinder at a relatively low operating pressure. When sufficient work load builds up, the pressure in the system increases and the pilot operated unloading valve *C* unloads the output of pump *A* while the output of pump *B* is still directed to the cylinder. The direction of piston travel is controlled by the four way control valve *F*. The horsepower requirement for this type of circuit is much less than if a single pump of sufficient volume and pressure were used.

Seam Welding and Miscellaneous Welding Processes

(Continued from page 27)

fluxing silver brazing alloy backing, so that when the work is placed between the electrodes and current and pressure (usually much lighter than for welding) applied, the solder melts, joining the contact firmly to the strip or armature. This soldering operation requires more time than for an equivalent weld, but the operation can be made completely automatic, the same as in welding. The electrodes usually are of a high resistance material such as tungsten or molybdenum to help generate the required heat. In this type of brazing, practically all of the heat is generated by the resistance of the work itself.

Another type of brazing, sometimes known as "incandescent" brazing is used for much larger joints. This type of joint is used for large copper and other non-ferrous joints. The electrodes in this case are carbon or graphite, and of relatively large section. When the work is placed between these electrodes and current applied, the electrodes themselves reach incandescence, radiating their heat into the work. When the heating has continued long enough, the solder melts, current is stopped and the joint is allowed to cool. This does not readily lend itself to automatic operation due to the variables in the electrodes themselves. However it need not be as the melting of the solder is clearly visible.

Other applications of resistance welding apparatus consist of electro-forging and upsetting. Production jobs of hot rivet provides a tighter and more uniform joint than is possible with cold riveting. Standard press type welding equipment and controls are used.

Some Influencing Factors in Tool Steel Heat Treatment

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THE ANALYSIS OF tool steels are so designed as to impart some special properties or characteristics to the tool or die, including wear resistance, toughness, non-deforming properties, resistance to the softening effect of heat. The heat treatment of single components of tools and dies differs from the heat treatment of tools and machine or structural parts that are manufactured in large production quantities. The reason for this is that in parts that are mass produced, pilot lots may be processed to determine response to heat treatment. Should inconsistent or irregular results occur in the treatment of pilot lots, processing can be altered to correct any difficulties, either in the pretreatment state or in the treatment itself.

These statements are, however, predicated on the existence of certain uniform conditions, for example: (1) parts are processed from a single heat of steel of uniform analysis, (2) physical condition before heat treatment is uniform from part to part regardless of the specific conditions of the material.

Problems do arise sometimes in the treatment of production parts because of too rigid specifications or improper selection of material. The heat treater is then called upon to exercise his ingenuity in order to meet these problems successfully.

The greatest problems confronting the tool steel hardener are those presented in the processing of single components of machine or structural parts, tools and dies. When a customer or tool room sends in a punch, special cutting tool, blanking die or a large die casting die mold, the heat treater cannot experiment to determine the proper method of treating since the cost of manufacture of any of these items may reach hundreds of dollars.

For the successful heat treatment of these costly items, it is necessary to have the utmost in correlation between the factors affecting the heat treatment of steels:

1. Condition of raw material

A. The chemical anaysis of the tool steel should conform to established standards. High chemistry heats may be detriments to successful heat treatment. Hardness, depth of hardening, size change and warpage can be affected by variations in chemical analysis.

B. The tool steel should be free of physical defects such as seams, laps and breaks on the surfaces since these defects are potential focii for cracking during heat treatment. Internal defects such as piping, forging bursts, flakes and ruptures are more difficult to detect and are serious offenders in the cracking of parts during heat treatment.

On one occasion a large eight inch diameter solid reamer of high speed steel was submitted for hardening. In order to facilitate uniform heating and cooling during the hardening process, the customer was requested to drill a hole completely through the center. During the drilling operation the drill, after penetrating several inches, dropped several more inches through a forging burst no one had suspected was present. It so happened that the final size of the drilled hole was larger than any portion of the forging burst, therefore the inside diameter cleaned up completely and the reamer was successfully hardened. Had the hole not been drilled, the reamer undoubtedly would have shattered in the hardening operation and the failure would have appeared to have been a result of heat treatment.

Severe carbide and alloy segregation at the center of a bar may act as focii for cracking, and especially so when exposed to a surface in a longitudinal plane.

Decarburization is considered a defect from the viewpoint of the heat treater since the transformation or hardening characteristics of the decarburized zone differs from that of the metal beneath. It is absolutely essential that decarburization be removed before heat treating lest the surface remain soft and the hazards of cracking in quenching be increased. Decarburization if removed nonuniformly from the raw material will also cause greater distortion. One of the most flagrant violations of good toolmaking practice is to take a skin grind on one side of a block of tool steel which is just enough to clean up the surface, than to turn the block over and remove perhaps an eighth of an inch. This might be compared to buying two inch thick bar stock to make a two inch thick die section.

Tool steels should be in a thoroughly annealed state before hardening. The microstructure should be 100 percent spheroidized, since this structure is the softest and the easiest to machine. In this condition the degree of carbide solubility which affects hardenability can be more accurately controlled when heating for hardening. Cracking hazards are increased if the steel is not thoroughly annealed.

2. Design

The design engineer plays an important role when designing machine parts or tools which require heat treatment. Cooperation between the design engineer and the metallurgist or heat treater should be fostered to bring about a proper balance among the various factors affecting the heat treatment of materials.

From the heat treating standpoint the designer should allow for generous filleting at changes in section and at the same time eliminate the use of sharp re-entrant angles. The greater the degree of symmetry in a given machine part of tool, the less hazardous is its heat treatment. In the case of blanking dies, to cite one example, it is not uncommon

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practice to drill holes adjacent to those already present in order to bring about equalization of mass to provide for uniformity in heating and cooling. The use of sectional dies simplifies heat treating problems while at the same time easing the problems of machining and grinding for the toolmaker.

In the design and manufacture of tools and dies certain dimensional tolerances are generally permitted although at times they may be quite small. Many parts are finished to size before heat treatment, necessitating precise control to prevent or minimize growth, shrinkage and distortion during the hardening process. Growth, shrinkage and distortion are functions of the design, analysis of the material and heat treating technique. Distortion is a result of differential heating or cooling while growth is due to the change in volume that takes place when steel is hardened. Shrinkage is a function of the design and cooling during quenching. Distortion can be generally corrected to a fairly high degree by straightening operations. Growth and shrinkage are difficult to control in complex shapes.

3. Heat Treating Practices

The heat treater in order to successfully harden tools and dies first of all must have the proper equipment without which he is doomed to failure. Heating for hardening is best done in controlled atmosphere furnaces wherein the carbon potential in the furnace is neutral to the carbon content of the tool steel, or in neutral salt baths. Both methods eliminate carburization and decarburization.

Temperatures used in hardening should be the minimum necessary to attain the hardness level desired. The use of excessive temperatures and/or heating times will generally result in excessive carbide solution and possible grain growth, both of which increase cracking hazards and tend to decrease die life. The rate of heating of any tool or die should be kept at a minimum to prevent excessive or differential movement during heating for hardening. It is generally considered good practice to preheat machine parts or tools during the hardening cycle.

The selection of the proper quenching medium is dictated by the analysis of the material and the design of the tool. Water hardening tool steels in small sections can be effectively hardened in oil. Large parts of carbon tool steels can sometimes be timed quenched in water, then transferred to oil in order to minimize distortion and cracking hazards.

Low melting point niter salts and high temperature quenching oils are extensively used in martempering or interrupted quenching to minimize distortion and quenching stresses.

In a given tool or die, the temperature gradient between two points will be less in oil than in water and will be much less in air than in oil.

Tempering should not be performed until the tool or die is thoroughly hardened. By this is meant that the part should be allowed to transform almost completely to martensite before tempering, otherwise some hardening may take place after the tempering operation. In case of high speed steels, a double tempering operation should be performed since steels of this type exhibit secondary hardening characteristics.

Straightening is one of the more hazardous operations the heat treater has to perform. It is preferable to straighten while the tool or die is still hot or better yet before the martensite begins to form from the austenite. A knowledge of the transformation characteristics of the various grades of steel is invaluable in straightening operations.

Many of the factors influencing the heat treatment of tools and dies have beeen discussed. Without question some may not have been given their proper weight of importance but this is rather difficult since the factors are so numerous and inter-dependent. It can readily be seen, however, that to eliminate problems in the heat treatment of tools and dies it is necessary to correlate the three essential phases relative to their manufacture.

The steel maker, the consumer and the designer can bring untold griefs upon the heat treater by improper application of material or improper design. The heat treater's job is perhaps the most difficult since he is working with the material in a plastic condition and subsequently hardening it during which time it undergoes severe thermal and transformation stresses. The heat treater is often called upon to correct errors of commission and omission initiated by the manufacture of the tool or die. Thus, the problems of the heat treater would be greatly reduced if proper cooperation between the steel manufacturer or purveyor, the steel consumer, the designer and the metallurgist is maintained.

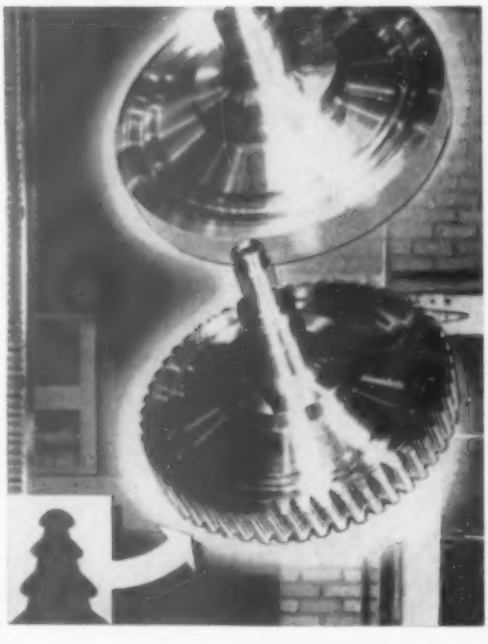
Broaching "Christmas-Tree" Forms in Turbine Wheels

Among the many interesting machining processes incidental to the manufacture of turbo-jets may be included the broaching of 53 "Christmas-tree"—shaped slots around the periphery of an 11¾ in. diameter turbine wheel.

The wheels are of tough 316 stainless, and the slots are ½ in. deep and 1⅝ in. length of cut, with the slots running at a 12 deg angle in relation to axis. As high production was not required, the tooling was engineered with economy in mind.

The machine used was a 10-ton, 54 in. stroke single-ram broaching machine, product of the American Broach & Machine Company, Ann Arbor, Mich. Broach tooling consisted of rough and finish insert assemblies mounted side by side on the single holder unit. The work holding fixture was mounted on a special receding work table, with the fixture designed to hold the work at the stated 12 deg angle in relation to the tool slide. The fixture was further designed so that the operator could laterally position the workpiece from the fixture plate.

Operating sequences, to broach the parts, are as follows: The part is secured on a manually indexed fixture. The slots are then rough broached around the entire periphery of the wheel at the first station. The complete fixture is then tranversed laterally to the second station, at which the "Christmas-tree" form is finish broached on all teeth.



Milling Cutter Design and Operation

Concluding Section

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OF THE MOST important cutting angles related to milling cutters, the rake angle has been described. Next is the corner or chamfer angle, which is used in face milling cutters to control the thickness of the chip removed by each tooth, by inclining the cutting edge along the periphery of the cutter at this angle. This is shown in Fig. 12.

When the corner angle is used, the length of the cutting edge along the chamfer should be made sufficiently long so that cutting will take place entirely along this part of the cutting edge. This permits an unobstructed flow of the chip. If double chamfer is used, the chip flow from the two chamfers will conflict and cause an increase in heat and stress particularly at the junction point (Figs. 13 and 14).

A single chamfer should always be used for blades tipped with sintered carbide material.

The combination of *radial, axial* and *corner angles* gives a resultant angle in the direction normal to the cutting edge along the chamfer, which is approximately the direction in which the chip will flow in face milling. This resultant angle is called the oblique or true rake angle (Fig. 15).

The value of the oblique rake angle for selected values of the corner, radial and axial rake angles are given in Tables II, III and IV. These tables show that it is possible to obtain positive values of the oblique rake angles, with a combination of positive and negative values of the axial and radial rake angles. This combination is to be preferred (in carbide application) to that in which the oblique rake angle would be negative because the chip flow along the face of the tooth will be freer with a positive than with a negative oblique rake angle.

Clearance Angle

The clearance angle is the angle ground on the back of a cutting tooth in order to prevent interference between the land and the surface being milled. Wear of the cutting edge resulting from the use of a milling cutter reduces the value of the clearance angle to the point where the land formed by wear begins to rub on the milled surface. To avoid further damage to the cutter and the surface being milled the value of the clearance angle must be restored by grinding.

To avoid poor cutter performance and too frequent resharpening, the clearance angle must be selected carefully.

It should be as small as possible so as to leave more metal for heat dissipation and insure maximum strength of the cutting edge.

In selecting the clearance angle, it is necessary to consider that for an equal amount of cutting edge wear, the resulting width of land is greater with a small than with a large clearance angle C_1. For example, outline 1 in Fig. 16 will require resharpening sooner than a cutter having a larger clearance angle C_2, like outline 2. For general purpose work, milling cutters from $\frac{1}{8}$ to 3 in. in diameter should have clearance angles from 13 deg to 5 deg, respectively, and decreasing proportionately as the diameter increases. In cutters over 3 in. diameter, the clearance angle is usually 5 deg.

The land is about 1/64, 1/32 and 1/16 in. wide for small, medium and large diameter cutters, respectively.

In addition to the clearance angle back of the cutting edge, which is known as the *primary clearance angle*, there is also a *secondary clearance angle*, which is provided to maintain the required width of land and contour of the tooth to avoid possible interference with the surface being milled (Fig. 17).

For any width of land L in., and dial indicator reading h, the clearance angle C_1, deg, can be calculated by means of the following formula:

$$C = \frac{57.32\ h}{L}$$

The diameter of the cutter has no effect on this measurement.

The diameter of a milling cutter is usually determined by

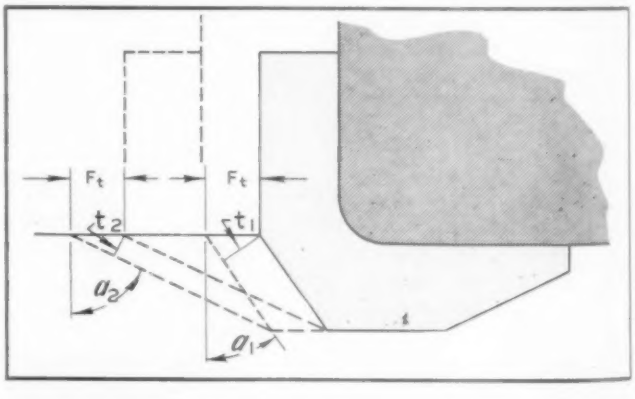
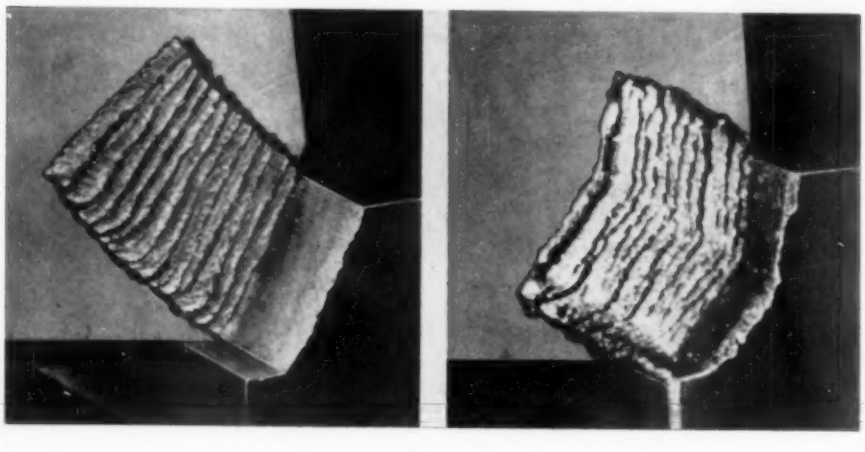


Fig. 12. (above). Use of the corner or chamfer angle in face milling cutters is shown in the diagram above. The angle serves to control the thickness of the chips removed by the teeth.



Figs. 13 and 14 (left to right) illustrate the possible effect of double chamfer, in that chip flow from the two chamfers is likely to conflict resulting in an increase in stress.

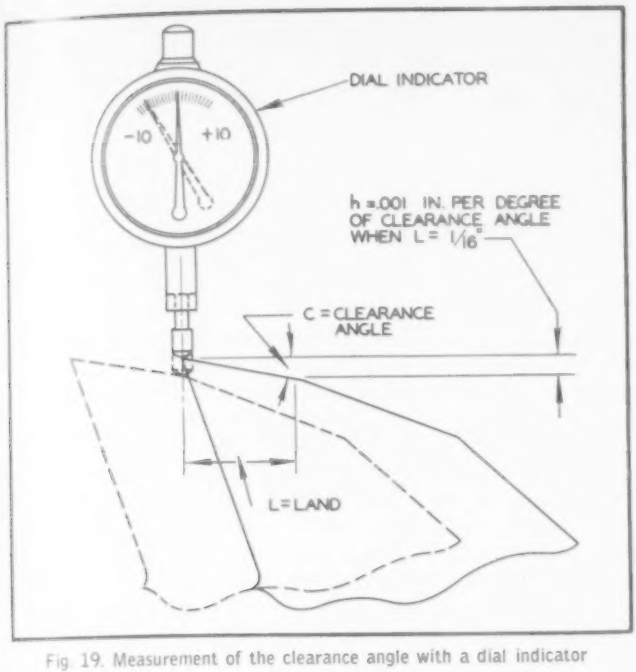


Fig. 19. Measurement of the clearance angle with a dial indicator

the nature of the milling operation, the width of the surface to be milled in face milling operations, the conditions of the setup, and the necessity of avoiding interferences or obstructions in the operation of the machine.

When the selection of the diameter can be made without definite restrictions, consideration should be given to the advantage to be gained by selecting the diameter on the basis of the thickness of the chip, because, for a given feed per tooth, the tooth load is greater on a small diameter cutter than on a large diameter cutter.

This is indicated by the undeformed chip thickness or the distance between two consecutive tooth-paths measured in a radial direction (Fig. 20). It should not be confused with the feed per tooth, which is the distance between two consecutive tooth paths measured parallel to the feed. The undeformed thickness of the chip section varies uniformly from the beginning to the end of tooth engagement with the work, whereas the feed per tooth remains constant from the beginning to the end of tooth engagement with the work.

By plotting the maximum undeformed chip thickness in relation to the feed per tooth, for different cutter diameters, there will result a relationship as indicated in Fig. 21.

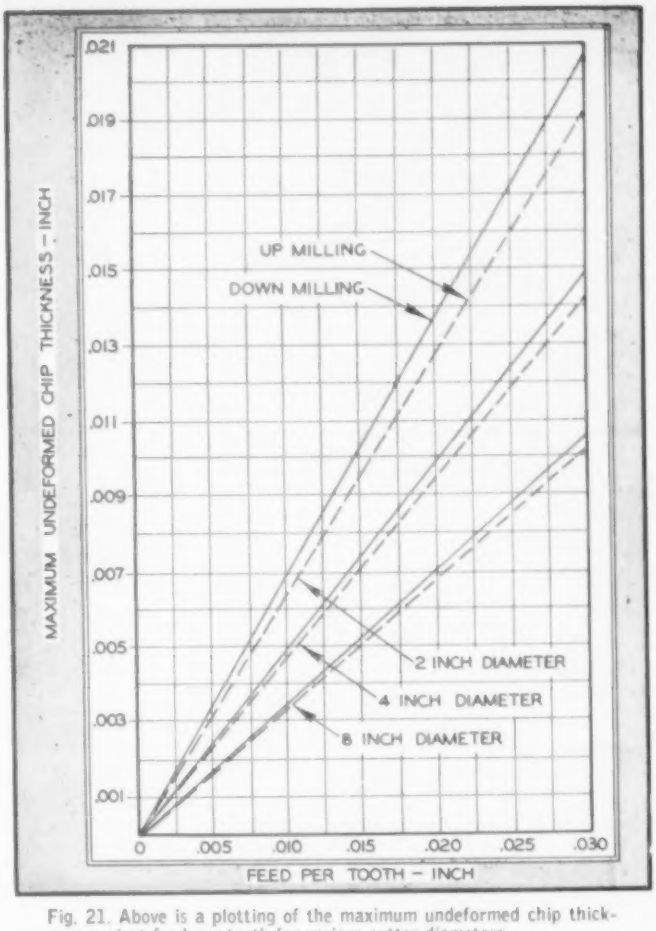


Fig. 21. Above is a plotting of the maximum undeformed chip thickness against feed per tooth for various cutter diameters.

At the feed per tooth of 0.01 in., the maximum undeformed chip thickness for a 2 in. diameter cutter is 0.007 in., but only 0.005 in. for a 4 in. diameter cutter.

Since this thickness decreases as the cutter diameter is increased, higher feed rates are possible with large than small diameter cutter, because the tooth load is correspondingly less with large diameter cutters.

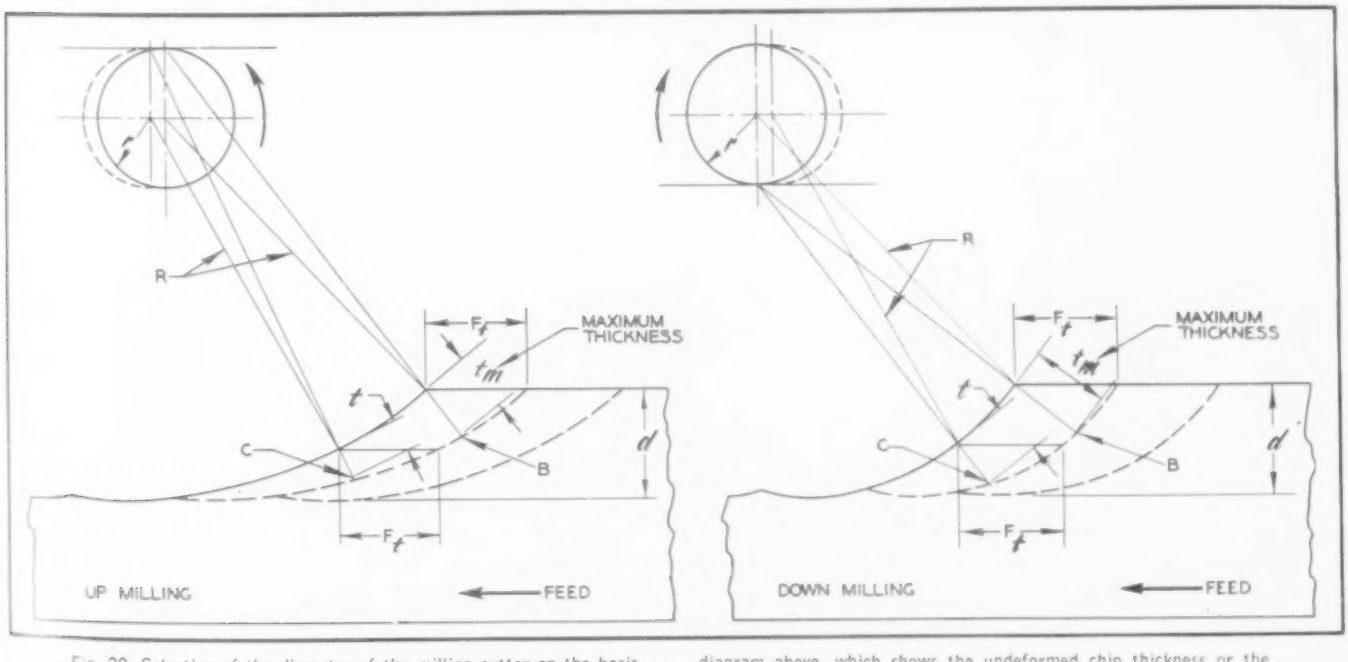


Fig. 20. Selection of the diameter of the milling cutter on the basis of the thickness of the tooth, where possible, is illustrated in the diagram above, which shows the undeformed chip thickness or the distance between two tooth paths measured in a radial direction.

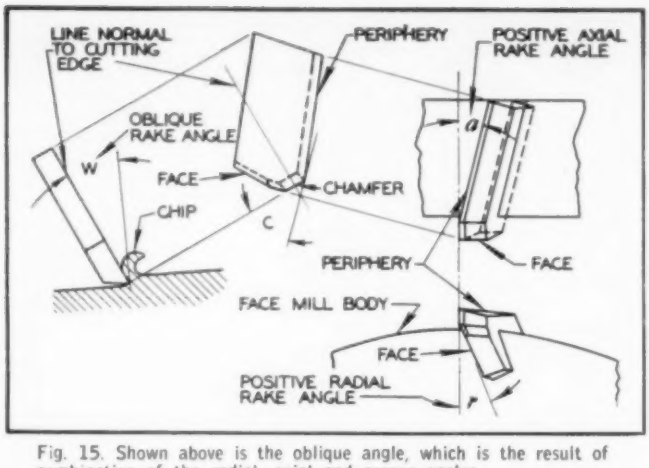


Fig. 15. Shown above is the oblique angle, which is the result of combination of the radial, axial and corner angles.

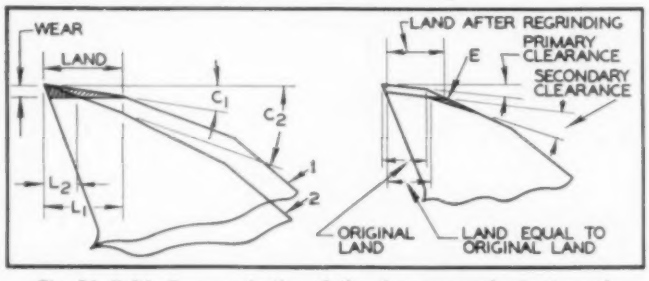


Fig. 16 (left). Proper selection of the clearance angles is stressed here. As pointed out in the text, outline 1, having a small clearance angle, will require resharpening more often than the cutter in outline 2, which has a larger angle. The secondary clearance angle, shown in Fig. 17 (right) maintains required width of land and contour of tooth to avoid interference with surface being milled.

TABLE 5 Clearance Angles for Various Work Materials

Material to Be Cut	Primary Clearance Angle	Secondary Clearance Angle
Low Carbon Steel	3°– 5°	6°– 8°
High Carbon and Alloy Steels	3°– 5°	6°– 8°
Cast Iron	4°– 7°	7°–10°
Medium and Hard Bronze	4°– 7°	7°–10°
Brass and Soft Bronze	10°–12°	13°–15°
Aluminum, Magnesium, Plastics, etc.	10°–12°	13°–15°

A line is drawn from the point 0.04 on the scale F_r to the point 0.250 on the scale d. The intersection of this line with line (n) is connected with point 3¼ on the (D-d) scale. The intersection of this line with vertical line (o) is connected to point 4 on scale D. From the point of intersection of this line with vertical line (p) is drawn a line to point 200 on Brinell scale B. This line intersects scale C_2 for the particular conditions of the example. The value of the clearance angle is $C = C_1 + C_2$ or 5.5 deg.

In many applications the value of C_1 is sufficient. In some other cases C_2, the component of the clearance angle due to the feed, depth of cut, and cutter diameter may have a large enough value to require adding to the value of C_1.

The clearance angle should be checked after each resharpening. Variation in this angle will cause a wide difference in cutter life. By avoiding such variations, average cutter life may be increased by at least 20 percent and often more.

The clearance angle can be easily measured by means of a dial indicator (Fig. 19), remembering that, for a 1/16 in. width of land, each degree of clearance is equivalent to approximately 0.001 in. on the dial indicator.

The secondary clearance angle is usually from 3 deg to 4 deg larger than the primary clearance angle.

The values of the clearance angle are also changed in ac-

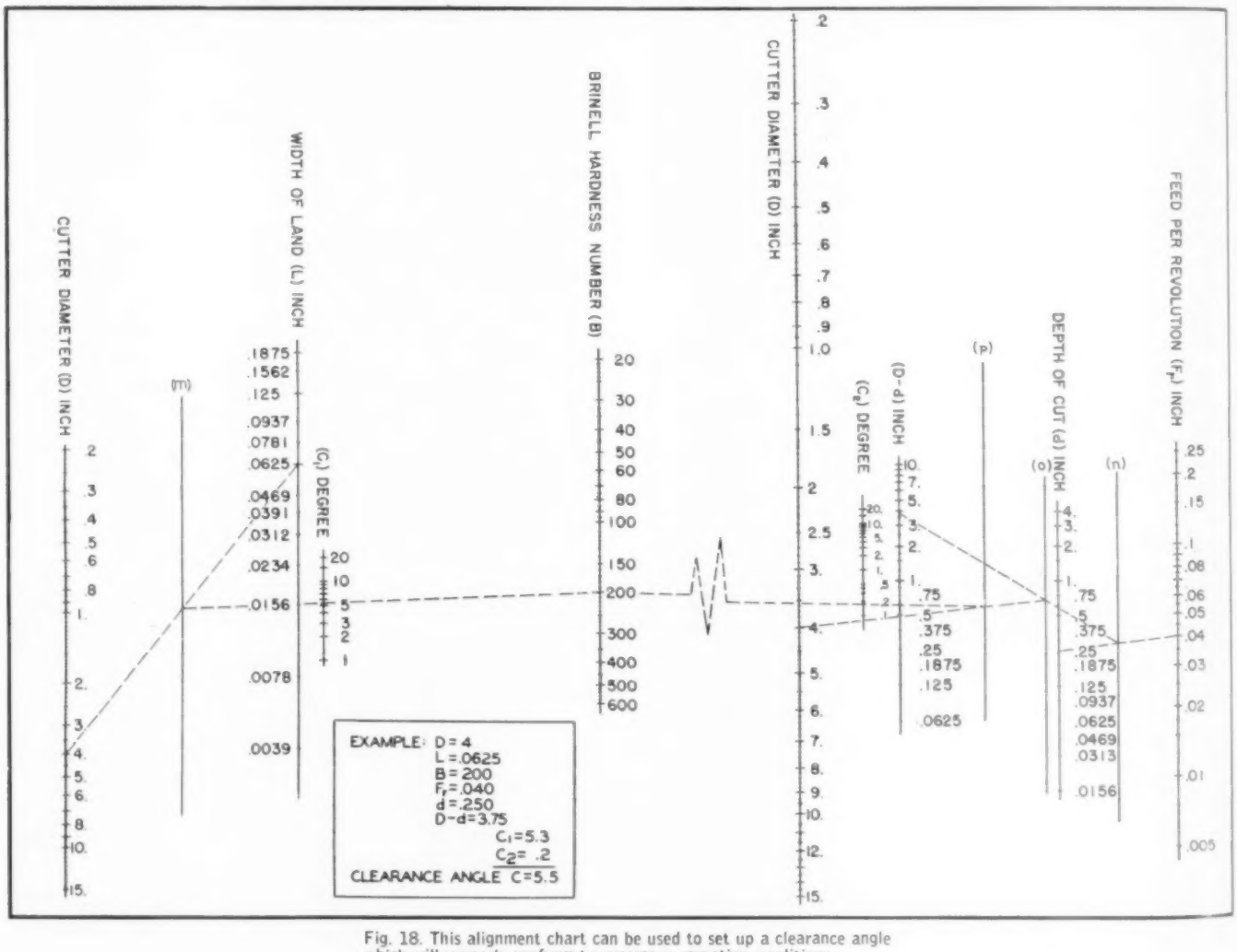


Fig. 18. This alignment chart can be used to set up a clearance angle which will properly conform to necessary operating conditions

TABLE II
Values of Oblique Rake Angle w in Face Mills Having a 15° Chamfer Angle

Axial Rake Angle a =	−30°	−25°	−20°	−15°	−10°	− 5°	0°	5°	10°	15°	20°	25°	30°
	Oblique Rake Angle w =												
−30°	−31° 29′	−31° 23′	−31° 12′	−30° 55′	−30° 29′	−29° 55′	−29° 9′	−28° 12′	−27° 0′	−27° 0′	−23° 52′	−21° 51′	−19° 28′
−25°	−27° 43′	−27° 22′	−26° 58′	−26° 28′	−25° 52′	−25° 8′	−24° 15′	−23° 11′	−21° 55′	−21° 55′	−18° 40′	−16° 38′	−14° 17′
−20°	−23° 59′	−23° 22′	−22° 44′	−22° 2′	−21° 16′	−20° 23′	−19° 22′	−18° 12′	−16° 52′	−15° 21′	−13° 36′	−11° 36′	− 9° 19′
−15°	−20° 14′	−19° 21′	−18° 29′	−17° 35′	−16° 29′	−15° 37′	−14° 31′	−13° 17′	−12° 5′	−10° 22′	− 8° 39′	− 6° 44′	− 4° 34′
−10°	−16° 25′	−15° 17′	−14° 11′	−13° 6′	−12° 0′	−10° 52′	− 9° 40′	− 8° 23′	− 7° 0′	− 5° 30′	− 3° 51′	− 2° 2′	− 0° 1′
− 5°	−12° 31′	−11° 8′	− 9° 50′	− 8° 34′	− 7° 20′	− 6° 6′	− 4° 50′	− 3° 32′	− 2° 11′	− 0° 43′	0° 50′	2° 30′	4° 20′
0°	− 8° 30′	− 6° 23′	− 5° 23′	− 3° 58′	− 2° 37′	− 1° 18′	0°	1° 18′	2° 37′	3° 58′	5° 23′	6° 53′	8° 30′
5°	− 4° 20′	− 2° 30′	− 0° 50′	0° 43′	2° 10′	3° 32′	4° 50′	6° 6′	7° 20′	8° 34′	9° 50′	11° 8′	12° 31′
10°	0° 1′	2° 2′	3° 51′	5° 30′	7° 0′	8° 23′	9° 40′	10° 52′	12° 0′	13° 6′	14° 11′	15° 17′	16° 25′
15°	4° 34′	6° 44′	8° 39′	10° 22′	12° 5′	13° 17′	14° 31′	15° 37′	16° 29′	17° 35′	18° 29′	19° 21′	20° 14′
20°	9° 19′	11° 36′	13° 36′	15° 21′	16° 52′	18° 12′	19° 22′	20° 23′	21° 16′	22° 2′	22° 44′	23° 22′	23° 59′
25°	14° 17′	16° 38′	18° 40′	20° 25′	21° 55′	23° 11′	24° 15′	25° 8′	25° 52′	26° 28′	26° 58′	27° 22′	27° 43′
30°	19° 28′	21° 51′	23° 52′	25° 35′	27° 0′	28° 12′	29° 9′	29° 55′	30° 29′	30° 55′	31° 12′	31° 23′	31° 29′

Radial Rake Angle r =

TABLE III Values of Oblique Rake Angle w in Face Mills Having a 30° Chamfer Angle

Axial Rake Angle a =	−30°	−25°	−20°	−15°	−10°	− 5°	0°	5°	10°	15°	20°	25°	30°
	Oblique Rake Angle w =												
30°	−34° 20′	−33° 14′	−32° 6′	−30° 55′	−29° 38′	−28° 11′	−26° 34′	−24° 43′	−22° 35′	−20° 9′	−17° 20′	−14° 6′	−10° 22′
25°	−31° 26′	−30° 0′	−28° 34′	−27° 5′	−25° 32′	−23° 51′	−21° 59′	−19° 56′	−17° 38′	−15° 2′	−12° 7′	− 8° 48′	− 5° 2′
20°	−28° 33′	−26° 47′	−25° 3′	−23° 17′	−21° 28′	−19° 33′	−17° 30′	−15° 16′	−12° 49′	−10° 8′	− 7° 8′	− 3° 48′	− 0° 6′
15°	−25° 38′	−23° 40′	−21° 30′	−19° 28′	−17° 25′	−15° 18′	−13° 4′	−10° 42′	− 8° 9′	− 5° 25′	− 1° 51′	0° 42′	4° 27′
10°	−22° 37′	−20° 12′	−17° 53′	−15° 37′	−13° 20′	−11° 3′	− 9° 41′	− 6° 13′	− 3° 38′	− 0° 53′	2° 3′	5° 13′	8° 39′
5°	−19° 27′	−16° 45′	−14° 10′	−11° 41′	− 9° 14′	− 6° 47′	− 4° 20′	− 1° 51′	0° 46′	3° 27′	6° 17′	9° 18′	12° 31′
0°	−16° 6′	−13° 7′	−10° 19′	− 7° 38′	− 5° 2′	− 2° 30′	0°	2° 30′	5° 2′	7° 38′	10° 19′	13° 7′	16° 6′
5°	−12° 31′	− 9° 18′	− 6° 17′	− 3° 27′	− 0° 46′	1° 51′	4° 20′	6° 47′	9° 14′	11° 41′	14° 10′	16° 45′	19° 27′
10°	− 8° 39′	− 5° 13′	− 2° 3′	0° 53′	3° 38′	6° 13′	9° 41′	11° 3′	13° 20′	15° 37′	17° 53′	20° 12′	22° 37′
15°	− 4° 27′	− 0° 42′	1° 51′	5° 25′	8° 9′	10° 42′	13° 4′	15° 18′	17° 25′	19° 28′	21° 30′	23° 40′	25° 38′
20°	0° 6′	3° 48′	7° 8′	10° 8′	12° 49′	15° 16′	17° 30′	19° 33′	21° 28′	23° 17′	25° 3′	26° 47′	28° 33′
25°	5° 2′	8° 48′	12° 7′	15° 2′	17° 38′	19° 56′	21° 59′	23° 51′	25° 32′	27° 5′	28° 34′	30° 0′	31° 26′
30°	10° 22′	14° 6′	17° 20′	20° 9′	22° 35′	24° 43′	26° 34′	28° 11′	29° 38′	30° 55′	32° 6′	33° 14′	34° 20′

Radial Rake Angle r =

TABLE IV Values of Oblique Rake Angle w in Face Mills Having a 45° Chamfer Angle

Axial Rake Angle a =	30°	−25°	20°	−15°	−10°	−5°	0°	5°	10°	15°	20°	25°	30°
	Oblique Rake Angle w =												
30°	35° 16′	33° 15′	31° 14′	29° 11′	27° 1′	24° 43′	22° 12′	19° 27′	16° 23′	12° 58′	9° 8′	4° 50′	0°
25°	33° 15′	30° 52′	28° 43′	26° 13′	23° 46′	21° 2′	18° 15′	15° 14′	12° 6′	8° 14′	4° 23′	0°	4° 50′
20°	31° 14′	28° 43′	25° 49′	23° 6′	20° 20′	17° 28′	14° 26′	11° 13′	7° 46′	4° 2′	0°	4° 23′	9° 8′
15°	29° 11′	26° 13′	23° 6′	20° 6′	17° 4′	13° 57′	10° 44′	7° 21′	3° 47′	0°	4° 2′	8° 14′	12° 58′
10°	27° 1′	23° 46′	20° 20′	17° 4′	13° 48′	10° 29′	7° 6′	3° 37′	0°	3° 47′	7° 46′	12° 6′	16° 23′
5°	24° 43′	21° 2′	17° 28′	13° 57′	10° 29′	7° 2′	3° 32′	0°	3° 37′	7° 21′	11° 13′	15° 14′	19° 27′
0°	22° 12′	18° 15′	14° 26′	10° 44′	7° 6′	3° 32′	0°	3° 32′	7° 6′	10° 44′	14° 26′	18° 15′	22° 12′
5°	19° 27′	15° 14′	11° 13′	7° 21′	3° 37′	0°	3° 32′	7° 2′	10° 29′	13° 57′	17° 28′	21° 2′	24° 43′
10°	16° 23′	12° 6′	7° 46′	3° 47′	0°	3° 37′	7° 6′	10° 28′	13° 48′	17° 4′	20° 20′	23° 46′	21° 1′
15°	12° 58′	8° 14′	4° 2′	0°	3° 47′	7° 21′	10° 44′	13° 57′	17° 4′	20° 6′	23° 6′	26° 13′	29° 11′
20°	9° 8′	4° 23′	0°	4° 2′	7° 46′	11° 13′	14° 26′	17° 28′	20° 20′	23° 6′	25° 49′	28° 43′	31° 14′
25°	4° 50′	0°	4° 23′	8° 14′	12° 6′	15° 14′	18° 15′	21° 2′	23° 46′	26° 13′	28° 43′	30° 52′	33° 15′
30°	0°	4° 50′	9° 8′	12° 58′	16° 23′	19° 27′	22° 12′	24° 43′	27° 1′	29° 11′	31° 14′	33° 15′	35° 16′

Radial Rake Angle r =

cordance with the material to be cut. (See Table V)

The clearance angle as provided in milling cutters does not remain constant in the actual operation, but varies during the tooth engagement with the work and the rate of feed.

To provide a clearance angle which will conform to operating conditions, such as feed rate, width of land, depth of cut, diameter of cutter and hardness of work material, the alignment chart shown in Fig. 18 can be used.

The clearance angle for any operating condition can be determined by adding the value C_1 obtained by proceeding from the group of scales at the left, and the value C_2 obtained from the group of scales at the right. The Brinell hardness scale in the center is common to both groups.

For the example shown in the chart, beginning at the left-hand side of the chart a line is drawn from point 4 on cutter diameter scale to point 0.0625 on width of land scale.

The intersection of this line with index line (m) is connected with point 200 on Brinell scale B. The line intersects the vertical scale C_1 for the condition of the example. For the evaluation of C_2 use scales at right of Fig. 18.

Proper Balance of Design Factors is of Major Importance

Designing Extrusion Dies for

By Carl Dovano

THE WATERBURY-FARREL
FOUNDRY AND MACHINE CO.

ESSENTIALLY, EXTRUSION is a process by which a billet of solid metal is converted into a continuous length of uniform cross-section by forcing it to flow, under high pressure, through a die orifice which is so shaped as to impart the required form to the product. In the main, it is a hot working operation, the metal being heated to give it a suitable degree of softness and plasticity. It can also, in some instances, be carried out in the cold. In the method chiefly adopted, cast billets of cylindrical shape, placed within a strong walled enclosure, are caused to extrude through the die orifice under the high pressure exerted by the ram, actuated hydraulically.

In the field of semi-finished products, it serves as a source of raw material which is well adopted for mass production methods, besides plain round, square, hexagon bars, and strips and tubes. So far as the more readily extrudable materials are concerned, almost any product which is required in straight lengths of uniform section comes within the compass of the extrusion method.

Materials Used

The extrusion die takes some of the heaviest punishment and is the tool which is subjected to the greatest wear in use. It must possess heat resistance and temper-retaining characteristics of a high order for its work in bringing about the deformation of the metal withstanding the abrasive wear which this causes.

The properties required involve a high degree of hot strength together with sufficient toughness to allow the die to adjust itself without risk of cracking. This involves a compromise in which most users incline towards toughness rather than extreme hardness, especially with dies of complex shape. The Brinell hardness can rarely be allowed to fall below 300 and is generally in the range of 320 to 375.

Heat Treatment

Heat treatment consists of quenching in oil from 2066 deg F to 2156 deg F and tempering according to requirements at from 1076 deg F to 1202 deg F. These tool steels, which are capable of retaining in use the properties imparted by the heat treatment, are austenitic in structure and possess superior properties at elevated temperatures. A typical composition is Co 4%, Si 1.3%, Cr 12%, Ni 12%, W 2%. A steel of this kind cannot be hardened in the ordinary way but its strength can be increased by cold forging the die blank in the first place.

The Shape of Extrusion Dies

The preparation of extrusion dies first calls for the making of a template, which takes into account:

1. Special characteristics of the metal to be extruded.
2. Allowances for stress and distortion.
3. The thermal contraction of the extruded section after leaving the die.

Using the template to lay out and gage the die and with normal precautions to assure the well-balanced flow of the metal into all parts of the die, the die-maker's job becomes fairly simple.

The die itself takes the shape of a comparatively thin disc, which fits accurately into a recess in the face of the press container. (Fig. 1.)

Radius vs. Pressure

In practice, many different profiles have been tried, often in an attempt to shape the entry in accord with the known streamline path adopted by the metal. As a rule, a radius is given to the front lip of the hole. (Fig. 2.) This almost

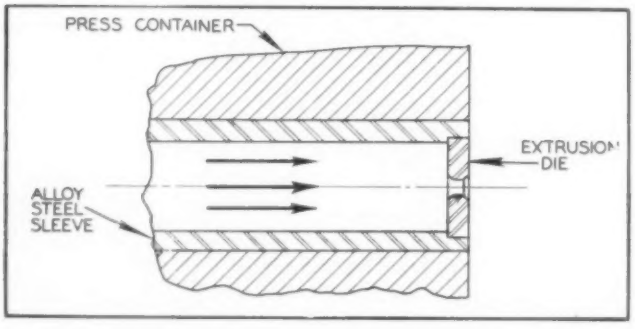


Fig. 1. A simple die layout for extrusion is shown here, with the die taking the shape of a thin disc and fitting accurately into the face of the press container.

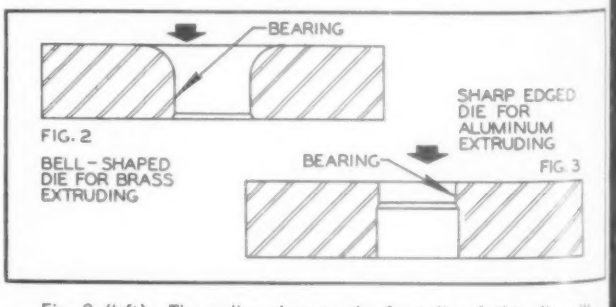


Fig. 2 (left). The radius given to the front lip of this die will cause a rise in pressure, but serves to prevent the closing-in which might occur with a sharp-edge die. Fig. 3 (right) illustrates the sharp-edge die which is used extensively with aluminum and its alloys.

Complicated Sections

certainly gives rise to a slight increase in extrusion pressure, but is desirable to prevent the closing-in which a sharp-edge die would suffer, and which tends to occur, in many cases, especially with metals requiring a high extrusion pressure. There is some evidence that the rounding of the lip helps to prevent surface cracking when extruding metals which possess low plasticity. Aluminum and many of its alloys, on the other hand, work best with dies approaching the sharp-edge category. The latter have a short bearing length and are well relieved on the side (Fig. 3) to do away, as far as possible, with the tendency of the aluminum to adhere to the surface of the die. Brass will also adhere to the die surface. To relieve this, the die is lubricated with a mixture of graphite and oil. A long bearing length, while it serves to strengthen the die and lengthen its life, restricts the easy flow of the metal; the bearing length is generally made from 3/16 to ½ inches long, being greatest for large diameter rods and easily extruded materials.

Dies for Involved Sections

On the highly specialized subject of dies for the more involved sections, a few examples of considerable interest warrant observation. For the extrusion of shaped sections which are of variable thickness in different parts, ingenuity is required to obtain a satisfactory distribution of flow through the die. The resistance to flow is lowest in the widest parts of the die and is highest where the section is narrow or in the vicinity of sharp corners, and hence the rate of flow tends to be variable. This is due partly to less deformation of the metal in the wider parts, and partly to the greater friction at the die surface and the increased cooling effect of the die at the narrow places.

Unless such faulty flow distribution is corrected, buckling and twisting of the extruded section may result, as well as tears and ragged edges in parts of least thickness. The general method of control is to increase the friction at the places where flow is easiest (Fig. 4); this is done by increasing the bearing length of the die or by opening it at the front to give a slight taper to the bearing at these points. The effect is to choke the flow at points of least resistance, and a marked influence on flow rate is noted.

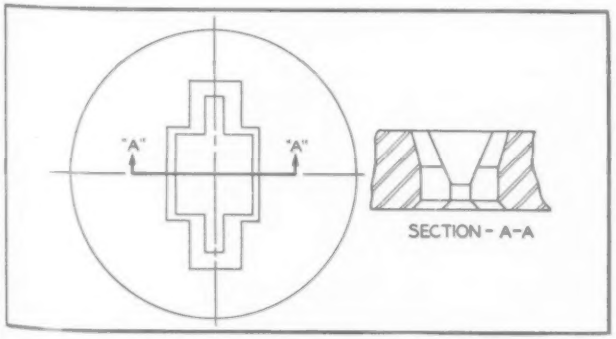


Fig. 4. Increasing the bearing length of the die or opening it at the front to provide a slight taper aids the extrusion of parts which have a varying cross section.

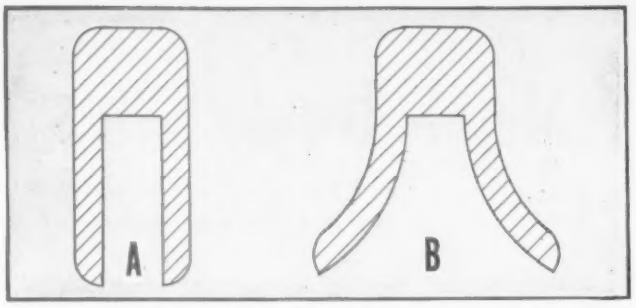


Fig. 5. For protection of re-entrant tongues, extrusion dies are often designed as shown at B above to splay the tongues and prevent fracture. After extrusion of the section, the flanges are cold drawn through a forming die, which brings the sides to a parallel position. Such precautions are particularly common when working with "stiff" alloys or with sections which have narrow flanges.

Protection for Re-entrant Tongue

Dies in which there is a re-entrant tongue, particularly in such engineering sections as channels, suffer from weakness owing to the difficulty of supporting the tongue (Fig. 5). This danger is greatest with "stiff" alloys, and in sections which incorporate narrow flanges, so that high pressures are required. To prevent the tongue from being pushed back or from being fractured across its base, the flanges are splayed out, as shown in Fig. 5 (a and b). These flanges are later cold drawn through a forming die to bring the flanges parallel to each other.

Fig. 5 (b) shows the section as it is designed on the extrusion die; Fig. 5 (a) shows the section after being cold drawn through a forming die to bring it to its correct shape.

Multiple-hole dies are often used in extruding small sections. It is obvious that the pressure required when several holes are provided will be considerably less than that for one hole of the same size. Actually the pressure when using several holes is reduced almost to that required for one large hole having a sectional area equal to the sum of the smaller ones, provided that the holes are not too far from the center of the die, since the flow of metal is greater at the center. An important factor concerning multiple-hole dies is that the holes must be of equal radius from the center of the die, to insure equal flow of metal.

Metal Flow Greater at Die Center

An experimental observation was made of one of the holes in the center of a four-hole die when a billet of brass was extruded about 10 feet before the metal from the outer holes started to extrude. This showed that metal flow is greater at the center of the die, and the rate of metal flow reduces as the holes are further away from the center of the die.

The process of extrusion has achieved within a short period a revolution, to some degree, in methods of metal-working, and its advantages, with the aid of alloy steels for die construction, are now felt in the economy of non-ferrous metals and alloys in many forms. Considerable progress has been made in the cold extrusion of non-ferrous sections, and engineers are looking forward to a similar degree of success in the production cold extrusion of the ferrous alloys.

REFERENCES

Pearson, *Extrusion of Metals*, Wiley, 1944.

By J. W. Lengbridge

Metal Requirements for Aluminum Presswork

Concluding Installment, with Appendix, of a Series on the Theory and Practice of Pressing Aluminum

METALS USED TO make pressings must satisfy both the needs of manufacturing processes and the specifications of the customer. The latter's needs may be ornamental appearance, quality of finish, strength, lightness, resistance to corrosion and accuracy of size and, along with one or more of these, the important one of low cost. By comparison, the needs of the shop are few but specific. The tools and methods described in preceding sections must perform mechanically and, at low cost, the operations necessary to change flat metal into the finished product.

Since the nature of the metal used determines the ease or difficulty with which it may be worked, some elaboration on this phase of presswork is in order if only to present the shop view. This will be done under the following four section headings: Metal Requirements; Selection of Alloys; Metal Defects; and Product Defects.

METAL REQUIREMENTS

Cutting, shallow forming and similar operations may be performed on metal of almost any alloy and temper and, presenting but few production problems, require but little proving or development. Deep drawing operations, however, demand maximum cold-working properties in order to produce the desired shape in a minimum number of draws. Hence, the metal must be capable of severe plastic deformation under the influence of the combined tensile, compressive and bending stresses incidental to such operations.

The fundamental requisites in a deep drawing metal are ductility and tenacity. As defined by Jevons, the first implies "the capacity to suffer plastic deformation under the influence of combined stresses, and therefore not comparable to percentage elongation as measured in a tensile test." Tenacity, as applied to deep-drawing-quality metal, is defined as the capacity to transform stress into strain—and, it may be added, into heat.

Both are equally important since, in addition to stretching, compressing and bending, sheet metal must be able to transmit tensile stress in order to draw adjacent portions through the regions of maximum pressure of the tool. Thus, when drawing starts, the large undrawn area is moved into the die by the tensile pull on the drawn area. Consequently, the metal in the drawn area must be capable of withstanding forces necessary to overcome the flow-retarding factors of blankholding pressure and compressive flow stress on the undrawn or flange area, without pulling apart in the drawn area. This is termed tenacity and, as Jevons states, is "inseparably linked with rate of work hardening."

TABLE 16—NOMINAL COMPOSITION OF ALUMINUM ALLOYS USED FOR DRAWING

Alcan Alloy	Copper	Iron	Magnesium	Manganese	Silicon	Chromium
Non-heat-treatable Wrought Alloys						
2S	....	....	....	....	....	....
3S	....	....	....	1.2	....	....
57S	....	....	2.5	....	....	0.25
Heat-treatable Wrought Alloys						
17S	4.0	....	0.6	0.6	....	....
24S	4.6	....	1.5	0.7	....	....
65S	0.25	....	0.9	....	0.6	0.23

SELECTION OF ALLOYS

Relatively few of the large number of commercially available alloys are commonly used in drawing operations. The nominal compositions and mechanical properties of those which are commonly used are listed in Tables 16 and 17; however, additional information on these alloys, with their properties and heat treatment, is contained in the *Handbook of Aluminum Alloys*, and in *Heat Treatment of Aluminum Alloys*, by Aluminium Company of Canada, Ltd.

In the non-heat-treatable group, the mechanical properties are produced by work-hardening as they are formed; hence, a greater amount of work can be done on them if the softer tempers are used as a starting point. However, many drawing operations can be done in the half-hard temper, and the less severe draws can be made in the full-hard temper. In this connection, temper is designated as O for fully-annealed, H for fully-hard; and ¼ H, ½ H and ¾ H for intermediate tempers.

In the heat-treatable group, the mechanical properties are increased by thermal treatments. The fully heat-treated temper of these alloys is designated by T. An intermediate—as quenched—temper of some alloys, including 65S, is known as W. The letter F—as fabricated—is applicable to both non-heat-treatable and heat- treatable alloys. As applied to

TABLE 17—Typical Mechanical Properties of Aluminum Alloys Used for Drawing

ALCAN	TENSION			HARDNESS	SHEAR	FATIGUE
Alloy & temper	Ultimate strength, psi	Yield strength, psi	Elongation Sheet spec. 1/16 thick, % in 2 in.	Brinell, 500 kg. ball; 10 mm. ball	Shearing strength, psi	Endurance limit, psi
2S-O	13,000	5,000	35	23	9,500	5,000
2S-¼H	15,000	13,000	12	28	10,000	6,000
2S-½H	17,000	14,000	9	32	11,000	7,000
2S-¾H	20,000	17,000	6	38	12,000	8,500
2S-H	24,000	21,000	5	44	13,000	8,500
3S-O	16,000	6,000	30	28	11,000	7,000
3S-¼H	18,000	15,000	10	35	12,000	8,000
3S-½H	21,000	18,000	8	40	14,000	9,000
3S-¾H	25,000	21,000	5	47	15,000	9,500
3S-H	29,000	25,000	4	55	16,000	10,000
57S-O	29,000	14,000	25	45	18,000	17,000
57S-¼H	34,000	26,000	12	62	20,000	17,500
57S-½H	37,000	29,000	10	67	21,000	18,000
57S-¾H	39,000	34,000	8	74	23,000	18,500
57S-H	41,000	36,000	7	85	24,000	19,000
17S-O	26,000	10,000	20	45	18,000	11,000
17S-T	62,000	40,000	20	100	36,000	16,000
Alclad 17S-O	.....	.....	..	..	.....	.....
Alclad 17S-T	56,000	33,000	18	..	32,000	.....
24S-O	26,000	10,000	20	42	18,000	12,000
24S-T	68,000	46,000	19	105	41,000	18,000
Alclad 24S-O	.....	.....	..	..	.....	.....
Alclad 24S-T	64,000	43,000	18	..	40,000	.....
65S-O	18,000	8,000	22	30	12,500	8,000
65S-W	35,000	21,000	22	65	24,000	12,500
65S-T	45,000	39,000	12	95	30,000	12,500

These articles are a collaboration between the author, Mr. Lengbridge, and the Aluminium Laboratories, Ltd., of Kingston, Ontario.

the former, this designation means that the temper has not been controlled. Applied to heat-treatable alloys, it means that the material has received no heat treatment after the final plastic deformation.

Available Finish

To accurately identify a specific material, it is necessary to state, among other considerations, the finish desired in addition to the alloy temper. Aluminum sheet can be obtained in the following finishes:

1. *Mill Sheet.* A fairly even grey finish, but may have streaks. Suitable where deep draws are to be made, where the surface is to be subsequently finished or where finish is not important. 2. *Commercial Sheet*, which has a consistently bright finish but may contain grey streaks. 3. *Flat Sheet*, which is finished on the flat finishing mills but, due to method of manufacture, will generally have a bright finish with possible streaks of grey. However, color is not necessarily a basis for rejection. 4. *Flat Sheet, lustre finish*, a uniformly bright finish free from streaks.

Considerations for Choice

The choice of alloy for a pressing should be governed by its ultimate use rather than by the amount of shaping involved. This means that, to obtain maximum utility in the product, metal which is not highly plastic may have to undergo severe plastic deformation. Due to their greatly superior drawability, as compared to heat-treatable alloys, the bulk of aluminum pressings are made from the non-heat-treatable alloys; however, these tend to wrinkle and pucker, and this tendency increases as purity increases.

The fact should always be considered that work-hardening alloys are strengthened in proportion to the amount of cold work they are given. And, when work-hardening will impart the strength and stiffness to a product to satisfy customer requirements, a fabricating process should not be made more difficult by unnecessarily specifying hard temper or strong alloys. During three drawing operations, for example, a dead soft Alcan 3S-O blank will work-harden to about Alcan 3S-$\frac{3}{4}$H on the sidewalls.

Because maximum plasticity is required, deep draws should be made from dead soft metal. However, harder tempers may sometimes be used for certain pressings and, in fabricating, will improve without further difficulty. Products requiring supplementary operations, such as beading and bulging, are often limited to soft metal because the initial cold work of the drawing operation may make the metal too hard for further shaping operations.

It is seldom necessary to anneal such alloys as Alcan 2S or 3S between draws. Alcan 57S has a much higher work-hardening rate than either of these, and experiments in severe spinning operations indicate that either additional draws or annealing between draws will be necessary for deep drawn product of this alloy.

Because aluminum is subject to critical strain crystal growth, sheet which has received a certain amount of cold work is desirable if the shape precludes forming without between-operations annealing. When annealed metal is used, a partly formed section will usually contain critically strained regions in which re-annealing will produce crystals of abnormal size. These regions will neck and cause failure during subsequent operations, but, if the original sheet is cold worked beyond the critical amount of strain, abnormal crystal growth will not occur in any part of the article during annealing.

While heat-treatable alloys are more difficult to draw, the greater strength obtained makes their use imperative for certain applications. While these alloys may best be drawn in the annealed condition, and subsequently heat treated, warpage which occurs during quenching may necessitate a restriking operation to correct this difficulty.

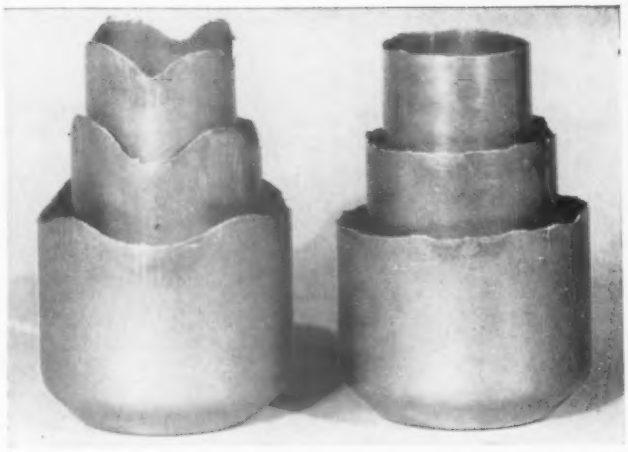


Fig. 143 shows, at left, a cup drawn from directional metal and, at right, one drawn from non-directional metal. The "earing" on the shell at left is evident in the first draw and becomes longer with each reduction in diameter. The top edges of the shells in the second group are comparatively even in height and indicate a desirable condition.

The artificially-aged alloys, which have relatively high plasticity for 24 hours after heat treatment, can frequently be drawn in the W condition and aged to obtain maximum mechanical strength. On severe draws therefore, the work should be done within 24 hours after solution heat treatment to take full advantage of this plasticity. Naturally-aging alloys cannot be severely drawn in the "T" condition. If a severe drawing is necessary, this should be done shortly after heat treatment. The length of time before drawing can be increased by holding the heat-treated material at a low temperature—say 300 deg F—to retard the precipitation of the hardening constituents.

Alloys in this group are newer than the work-hardening alloys. Consequently, as their possibilities for deep drawn products are not widely known, their use may necessitate changes in tooling and a more involved manufacturing process because of the rapid change in properties. However, the products from these alloys are much stronger and the competitive field considerably wider.

With the increasing substitution of aluminum and its alloys for brass and steel, particular care should be taken in selecting a suitable alloy and temper if the dies were originally built for steel or brass. When experimenting with aluminum in their dies, manufacturers are inclined to attribute failure to the metal when, as a matter of fact, some slight change in tool radius, lubricant or other factor would produce perfect shells.

Excessive blank-holding pressure, ironing effect, or drag due to built-up thickness, excessive diameter reduction, and so on, are just a few of the things which will cause more trouble with aluminum than with brass or steel. However, there is need for more exact data on the drawability of the various alloys and tempers, and such data would make it possible to use the strongest metal which could be given the required amount of shaping and also result in greater utility of the product.

METAL DEFECTS

The importance of grain size in determining the plastic properties of the metal suggests that this quality should be thoroughly explored when developing new deep-drawing alloys. A large variation in grain size seriously affects the basic requirements of deep-drawing metals with regard to ductility and tenacity. As the grain size increases, drawing quality decreases.

Extremely large-grained metal is not good for deep drawing. It tends to neck and fracture or to show an "orange

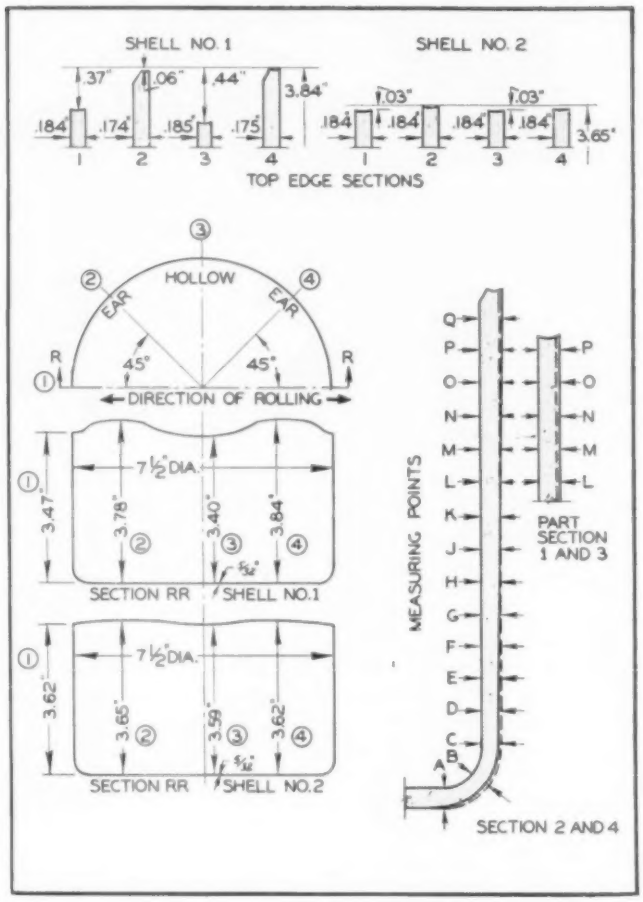


Fig. 144, showing comparison between directional and non-directional metal. Shells Nos. 1 and 2 were drawn on the same hardened-steel tools, with the press in good condition. The same size blank was used in each case. Reduction between blank diameter and shell was 43%—not at all severe—and lubrication was with Imperial 600-W, the whole presuming excellent conditions for production of first-class shells. Two different lots of Alcan 2S-0 were used. Shell No. 1 was drawn from metal having directionality at 45 deg to the direction of rolling. Shell No. 2 was drawn from metal having little or no directional tendencies. The maximum difference in height on sections through ears and hollows was $\frac{7}{16}$ in. on shell No. 1 and $\frac{3}{32}$ in. on shell 2—that is, the increase in depth through the ears due to increased plasticity amounts to 13% with directional metal and 1.7% with non-directional metal. Measurements through sidewall sections 1 to 4, both shells, are shown below in Tabulations A and B.

Tabulation A. Measurements of Thickness of Shells Nos. 1 and 2, Fig. 144

Relation to rolling	Paral'l 45°		Across 45°		Paral'l 45°		Across 45°	
Top edge condition	Hollow ear		Hollow ear		Hollow ear		Hollow ear	
	Thickness through vertical sidewall sections							
Measuring points	Sections 1-4, Shell No. 1				Sections 1-4, Shell No. 2			
	1	2	3	4	1	2	3	4
Q	....	.178	....	.180	....	....	....	....
P	.184	.174	.185	.175	.184	.184	.184	.184
O	.183	.170	.185	.169	"	"	.183	"
M	.181	.165)b	"	)b .165	)b "	.179	.182	.181
N	.178)b	.162	.181	.161	.178	.173	.172	.174
L	.169	.158	.170	.159	.170	)b .168	)b .168	)b .169)b
K	.161	.154	.162	.154	.164	.161	.163	.162
J	.156	.151	.156	.152	.159	.157	.158	.157
H	.153	.148	.153	.146	.153	.152	.153	.154
G	.148	.145	.148	.143	.151	.149	.149	.150
F	.146)a	.146)a	.146)a	")a	.149	.148	.148	.148
E	.141	.140	.141	.141	.147	)a .145	)a .146	)a .146)a
D	.148	.148	.145	.149	.148	.151	.149	.148
C	.133	.135	.134	.135	.143	.144	.143	"
	Bottom Radius						Bottom Radius	
	.134)a	.136)a	.136)a	.136)a	.139)a	.139)a	.139)a	
	Bottom Shell						Bottom Shell	
	.153)c	.153)c	.153)c	.153)c	.153)c	.153)c	.153)c	.153)c

Key:)a = Wall thickness reduction;)b = Wall th'kn's increase;)c = No change in thickness

Tabulation B. Thickness Variation Which Occurred on Shell No. 1, and the Uniform Thickness on Shell No. 2, Through Any Selected Measuring Point, Fig. 144, Are Summarized Below.

	Shell No. 1				Shell No. 2			
Sections Nos.	1	2	3	4	1	2	3	4
Relation to rolling	As in Tabulation A							
Edge condition	Hollow ear				Slight ears & hollows			
Section depth, in.	3.47	3.78	3.40	3.84	3.62	3.65	3.59	3.62
Depth variation	0.31		0.44		0.03		0.03	
Max. thickness increase, in.	0.031	0.025	0.032	0.027	0.031	0.031	0.031	0.031
Max. thickness increase, %	20	16	20	17	20	20	20	20
Max. thickness decrease, in.	0.020	0.018	0.019	0.018	0.014	0.014	0.014	0.013
Max. thickness decrease, %	13	12	13	12	9	9	9	9

peel" effect at points of severe stress—such as at the corners of shells—and may possibly split on deep draws. Moderately coarse-grained metals may not split but orange peeling may occur along with a rough radius between sidewalls and bottom. The "as drawn" finish from such metal is not satisfactory if the forming is to be subsequently polished; also, cost of polishing will be considerably increased. If the grain size is very small, the metal may not be quite as ductile as larger grained metal. However, small-grained metal is much preferred because of its higher tenacity and smoother appearance after drawing.

Directionality

Directionality implies appreciable variations in the physical properties of sheet metal according to a direction relative to some line of reference, usually the direction of rolling. Metal having pronounced directional properties will assume a wavelike formation at the top edge or flange of a shell. The high points of this formation are known as "ears", the height of which on any given shell indicates the degree of directionality.

The ears are usually four in number, and may lie across and with the direction of rolling. Or, they may lie at 45 deg to the direction of rolling, depending on the procedure used in making the metal. In experiments with various rolling and annealing procedures, for example, brass has been produced which formed six ears on a drawn cup. On the other hand, experiments with Haslett metal, in drawing and spinning operations, indicated an absolute lack of directionality.

The rolling and annealing procedures used to make sheet largely govern the extent or degree of directionality; however, some alloying elements also tend to impart slight directional properties. See Figs. 143, 144, 145 and 146 for effects of directionality and also Table 18, showing how metal for the shells illustrated was fabricated.

Consider that the rearrangement of area units in a drawing operation occurs before the metal passes over the die radius—that is, while it is still between the blankholding faces of the tool. The lower plasticity of the metal through the hollows results in less flow in a horizontal plane and

TABLE 18—FABRICATION OF METALS

Identification	GTK-43-4	GTK-44-54
Alloy	Alcan 2S	Alcan 3S
Hot rolled to	0.299 in.	0.402 in.
Rgh " "	0.120 in. 3 passes	0.090 in.
Inter-anneal to	430°C for 2¼ hrs.	490°C for 2¼ hrs.
Rgh rolled to	0.068 in.—1 pass	.....
Inter-anneal at	427°C for 2½ hrs.	.....
Fin. rolled to	0.028 in.—1 pass	0.028 in.—2 passes
Final anneal	410°C in continuous furnace	425°C in continuous furnace

Fig. 145, showing how extremes in directionality can affect flow in a drawing operation. The shell at left shows an extreme case in which the ears are 1½ in. long and the walls at the hollows wrinkled. While made from much thinner metal, the shell at right is also badly eared. The ears on the first shell lie at 45 deg, and those on the shell at right at 90 deg to direction of rolling. The metal used for these shells is not typical of average metal; however, earing can be much less pronounced and yet constitute a press room problem.

since the volume through any unit section remains constant, in a corresponding increase of flow in a vertical plane as well.

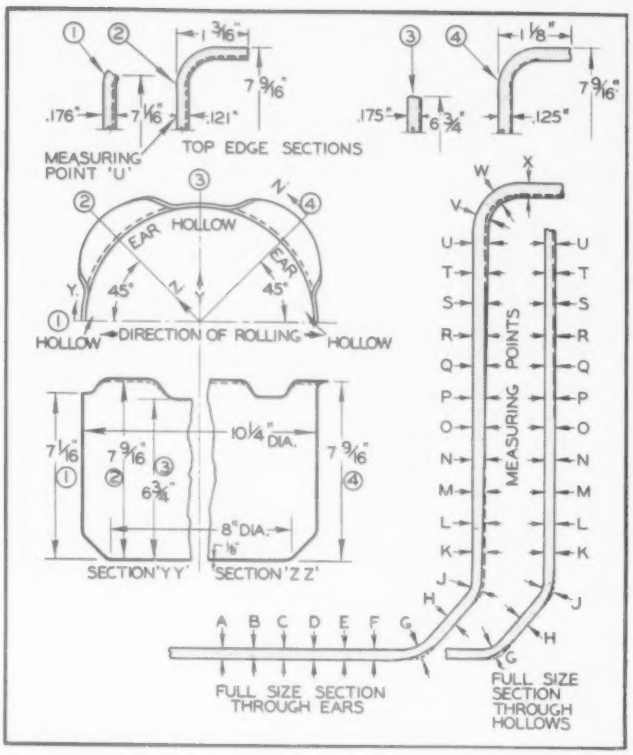
The high plasticity through the ears results in increased depth, while the lower plasticity through the hollows results in increased thickness. The measuring points shown on the sidewall section view in Fig. 144 are taken at the same height through sections 1, 2, 3 and 4 of both shells, and a study of the thickness through some of these points in the upper wall area, where the flow is greatest, will show that the thickness difference is quite substantial between sections 1 and 2—or between 3 and 4—on shell No. 1, but very little on shell No. 2.

The greatest decrease in thickness occurs where the metal is bent to conform with the bottom radius of the punch, while the greatest increase occurs at the top edge of the shell where flow is maximum. While the thinning effect of bending is somewhat balanced by the thickening effect of flow, the amount of flow in the lower shell wall is not sufficient to completely balance the amount of thinning which has occurred. Up to a certain height from the shell bottom, then, the wall thickness will be less than the original blank thickness. At this height, the wall thickness will equal the original blank thickness and, from this point to the top of the shell, will increase in excess of the original thickness.

With non-directional metal, the point where thickness increase occurs will be uniform. With directional metal this point will be higher through the ears than through the hollows, and the amount of thickness increase will vary also. Referring again to Fig. 144, the metal in shell No. 1 increased from 0.134 in. to its original thickness at measuring point H through the hollow, and point K through the ears. In shell No. 2, this occurs at point H through all sections. See tabulations that supplement Fig. 144.

The shell shown in Fig. 145 was sectioned and measured as shown in Fig. 146. It will be noted that no change in thickness has occurred to the metal on the bottom of the shell, and the thickness change at other points is indicated by the long dash line on the full-size wall sections. Where this line is outside the shaded section, the metal thickness is less than the original blank thickness. Where this line is inside the shaded section, a thickness increase has occurred.

It will be noted that the greatest reduction occurs at the bottom radius, and is maximum at sections 1 and 3—that is, through the hollows. Maximum reduction occurs at corner G, because the thickness increase through these sections during the operation was sufficient to retard flow and to



Dimension Details of Shell at Left, Fig. 145

Tabulation C

Section No.	1	2	3	4
Relation to rolling	Parallel	45°	90°	45°
Top edge condition	Hollow	Ear	Hollow	Ear
Measuring Point		Top Flange		
X	.....	0.132	.....	0.132
W	.....	0.130 b	.....	.0132 b
		Top Corner Radius		
V		0.129 b		0.132 b
		Vertical Shell Wall		
U	0.176	0.121	0.175	0.125 b
T	0.170	0.118	0.173	0.120
S	0.160	0.114	0.169	0.116
R	0.149 a	0.112	0.156	0.114
Q	0.140	0.111	0.140	"
P	0.133	0.110 a	0.132 a	0.113
O	0.126	"	0.124	" a
N	0.120	0.112	0.119	"
M	0.115	"	0.112	"
L	0.112 a	"	0.106	0.112
K	0.110	0.113	0.108	0.113
		Upper Bottom Corner Radius		
J	0.115 a	0.118 a	0.115 a	0.116 a
		Center of Bevel		
H	0.125 c	0.124 c	0.123 c	0.123 c
		Bottom Corner Radius		
G	0.093 a	0.114 a	0.093 a	0.114 a
		Bottom of Shell		
F Through A	0.125	0.125	0.125	0.125

Key: a = Wall thickness decrease; b = Wall thickness increase; c = No change

Tabulation D, Summarizing Thickness Changes and Length Variations, Fig. 146

Section No.	1	2	3	4
Relation to rolling and top edge condition as stated.				
Depth of shell, in.	7 1/16	7 9/16	6 3/4	7 9/16
Length of ear, in.		1 1/4		1 1/2
Max. thickness increase, in.	.051	.007	.050	.007
Max. thickness increase, %	40	6	40	6
Max. thickness decrease, in.	.032	.009	.032	.009
Max. thickness decrease, %	26	8	26	9

subject the metal at the first bend to the full drawing load. The center of the bevel shows no change and the second

radius shows a decrease in thickness, due also to the bending over the corner of the punch.

The change in thickness in the side wall sections follows the same trend as on Shell No. 1 in Fig. 144, but is more severe. The thickness increases at points R to U, through sections 1 and 3, were sufficient to fill up the die space entirely. The shell wall at these points is well burnished, indicating that, had there been greater clearance in the die, the thickness increase might have been even more pronounced. Measurements of thickness of the shell in Fig. 146 are tabulated with the caption.

The effects and characteristics of directionality on the metal may be briefly summarized as follows:
1. Directionality causes certain portions of the shell wall to draw out in the form of ears with intervening deep hollows. 2. The ears are usually four in number and are specified as occurring in a direction relative to the direction of rolling, usually at 45 deg but, sometimes, with two parallel to and at 90 deg to the direction of rolling. 3. Thickness of the shell wall through the ears will be less than the thickness through the hollows. 4. The length of the ears, and the extent of thickening at the hollows, indicates the degree of directionality. 5. The hollows may come below the trim line and therefore necessitate the use of larger blanks in order to obtain full depth. 6. The excessive thickness increase may add to ironing loads to the draw, causing fractured shells. 7. On non-circular shells, directionality may result in excess metal occurring at places where free movement is desired.

Surface Defects. While surface defects in the sheet can be troublesome on certain products, they are not necessarily a frequent cause of press scrap. Surface finish is broken by the flow in deep draws and, if the product is to be polished, the open appearance of the surface may be polished on wheels or ironed smooth in a lathe or press operation.

The surface of coarse-grained metal will open up when severely drawn and, in extreme cases, cannot be ironed smooth. Then, oiling operations are necessary to obtain the bright finish required on such products as utensils. Blisters, rolled-in scratches, slivers and other flaws may start fractures or leave surface defects which must be oiled out. Often, these become flat spots or hollow areas which may be visible despite high polish and may therefore spoil both appearance and the general contour of the product.

Sheet to be used for drawing should neither be accepted nor rejected on the basis of surface finish alone. Good drawing metal with a poor surface finish may be quite satisfactory after drawing; inversely, metal with a flawless finish but of poor drawing quality will open up excessively and may necessitate additional polishing. See Fig. 147 for examples.

Temper Variation. A nominal value is established for tensile and yield strength, elongation and other properties for each work-hardening alloy in each grade of hardness. The tolerances above and below this nominal value are the minimum and maximum values acceptable in each temper. As the high value in one temper is quite close to the low value in the next temper above, there is very little difference between soft metal on the maximum end of its range, and ¼ hard metal on the minimum end.

This variation from dead soft to almost ¼ hard on metal specified as soft can create trouble in pressing operations when such metal is subjected to severe deep draws. On the other hand, if ½ hard metal is specified for a pressing requiring strength, it may actually be little better than ¼ hard. It may be too soft to produce a structurally strong product, or, it may be close to ¾ hard and therefore too hard to fabricate without fracturing the metal.

Gage Variation. Usually, gage variation is not a serious disadvantage except, possibly, in limit draws on metal having a low thickness-to-diameter ratio. The rolling tolerances are

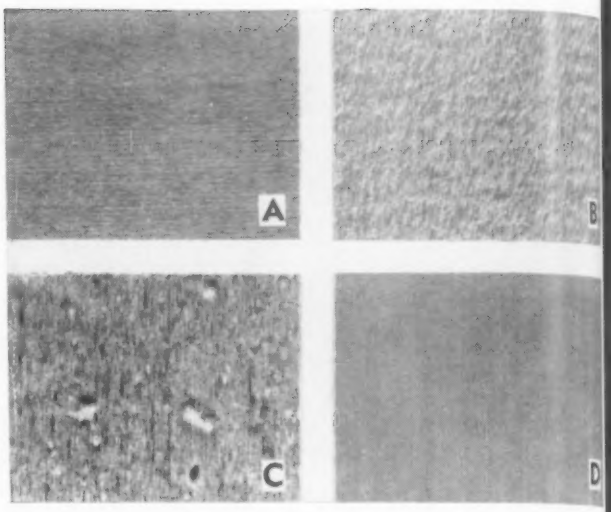


Fig. 147, showing surface finishes before and after drawing. A, at top left, shows a sheet surface before drawing, and B—top right—the surface after drawing. Here we have an example of sheet with good surface finish but poor drawing qualities. The two lower photographs illustrate sheet with poor surface finish but good drawing qualities. C shows the original sheet surface and D the surface after drawing.

usually well within the draw clearance used on the dies. Except for the cases mentioned, then, it is usually possible to draw metal one or two gages above or below that for which the dies are made. Blanks having a t/d ratio of less than 0.002 in.—or .2 percent—are quite difficult to draw and, when worked to the limit, require more exacting conditions for best results. A smaller thickness tolerance than standard would be helpful for these difficult draws.

Water Stains. As a general rule, water stains do not affect the drawability of aluminum sheet unless particularly bad. However, they do constitute a defect of finish when the product is being supplied in the natural finish—that is, not polished. For large flatware—such as serving trays or panels—the stains will be unsightly and, if the staining medium etches the surface, polishing with emery may be necessary to remove the pitted areas. As the defects outlined in this section are reduced or eliminated, more severe reductions and better as-drawn surface finishes will be possible, with resultant manufacturing economy.

PRODUCT DEFECTS

Flange wrinkles, such as radial ridges on the shell flange metal which has not yet passed over the die radius. Causes: insufficient blankholding pressure; excessive amounts of heavy lubricants; die and blankholder faces not parallel; the remote possibility of pronounced variation in thickness at different parts of the blank.

Wall wrinkles, as vertical ridges on the side wall of drawn shells. Causes: insufficient blankholding pressure. These wrinkles occur when the metal is in the flange area, and are carried over the die radius; too large a die or punch radius, or both; excessive clearance between punch and die; faulty tool setting, such as die not centrally located with the punch, thus allowing more clearance on one side than the other.

Puckers: A form of wrinkle appearing on the walls of domed or tapered shapes, in the form of wide ripples running down from the flange. Causes: insufficient blankholding pressure; too few drawing operations, particularly on aluminum.

Step rings: Deep circumferential lines or depressions on the side walls of shells given two or more draws. Causes: radius on punch bevel too sharp; radius on blankholder bevel too sharp; radius on redraw die too sharp.

Draw marks; outside: Vertical score lines on the outside of the shell. Causes: rough draw surface, particularly on draw radius; pick-up particles adhering to the die; dirt and

foreign matter on the metal, die or lubricant; inadequate lubrication.

Draw marks, inside: Vertical score lines on the inside of the shell. Causes: rough punch walls; dirt and foreign matter on the punch.

Nipped edges: Top edge of drawn-through shells nipped off or pulled thin. Caused by lack of counterbalance for weight of a blankholder ram.

Orange Peel: Rough or open appearance at the corners of a drawn shell. Causes: grain size of metal too large; annealing between draws. Portions of the shell which have not received sufficient cold work to recrystalize on annealing. Flow resistance factors such as excessive blankholding pressure on sharp die radius.

Flaking: Small irregularly-shaped areas where a section of the surface metal flakes off, leaving a depression. Causes: slivers and metal surface defects; nipped edge particles left in the tools from previous shells, being impressed into the succeeding shell or blank.

Scratches: Surface scratches running in all directions, caused by stacking without protecting material between shells, or by careless handing of blanks in shipments.

Pits; as small pin point depressions on the surface of the shell, caused by bottoming too hard on rough or porous tools.

Fractures, or necked appearance on bottom corner of shells. Causes: excessive blankholding pressure; punch radius too small; on redraw tools, too sharp die radius; insufficient clearance, adding ironing loads to the drawing loads; metal defect, as coarse grain; insufficient blankholding pressure, allowing wrinkles to form and preventing flow.

Fractures, at top corner of flanged shells. Causes: die radius too small; poorly blended die radius; insufficient clearance; excessive blankholding pressure.

Fractures, on sidewalls. Breakdown parallel to the direction of rolling, caused by structural weakness in the metal or by metal too hard to draw.

Fractures, corners of rectangular shells, being necking or fractures at one or more of the four corners. Causes: punch corner radius too small; excessive blankholding pressure on blank in corner areas; insufficient blankholding pressure through corners, preventing flow.

Miss-Strike. Uneven shell height or flange width, or evidence of burnishing on sidewall at one end. Causes: incorrect tool setting; die diameter not concentric with punch; punch out of alignment with die; blank skidding due to uneven blankholding pressure; incorrect centering of blank on the die; wide variation in metal thickness at different parts of the blank. The latter, however, is unusual.

Earing, uniform directional. High points or ears at the top edge of the shell with hollows between, usually in a definite relation to the direction of rolling. Caused by pronounced directionality.

Earing, non-uniform directional. One or more high points on shell top not in definite relation to the direction of rolling. The cause is worn die or blankholder, causing pinch.

Burnished spots, uniform. Wide portion of shell wall highly burnished as compared to the normal condition of a narrow burnished band at top edge. Caused by insufficient clearance.

Tool ears, similar to but not to be confused with directional ears. High points or points at top of shell, the metal below the point or points having a burnished appearance. Usually more common on deep draws with thin material. The cause is a low spot on the die or blankholder, allowing a build-up or thickening to occur which is later ironed out by the die.

Thickness variation, as a substantial thickness variation on shells press-ironed to reduce wall thickness or to make uniform. Caused by lack of sufficient guides between punch and die, or by excessive looseness in press ram.

APPENDIX

In concluding this Series on Aluminum Presswork, the author wishes to acknowledge, with thanks, permission to quote from "Plastic Working of Metals," by E. V. Crane (John Wiley & Sons); also, from Jevons' "Metallurgy of Deep Drawing and Pressing," as well as from various magazine articles. Also gratefully acknowledged is use of photographs, as from E. W. Bliss Company, Detroit, and other makers of press products and equipment. These sources, together with the cooperation of Management of Aluminum Goods Limited, Toronto, Ontario, and Aluminium Laboratories Limited, Kingston, Ontario, have been most helpful in the preparation of this series of articles.

John W. Lengbridge

Editors' note

Providing, as it does, the answer to numerous questions relative to Aluminum Presswork, and further in view of a marked reader interest, this collaboration by Mr. Lengbridge and Aluminium Laboratories Limited may well be considered an outstanding contribution to the know-how of metal processing.

That errors of omission or commission should occur were almost inevitable considering the many formulas and line drawings, as well as the abridgements involved in editing so comprehensive a work. Except for obvious typographical errors and others of relatively minor importance, these errors are listed below with notes for correction. Readers who have filed the series should therefore check off these errors on the pages indicated, along with a reference to the Appendix.

The Editors

Corrections

For brevity, Installments are designated by Inst.; month and year by numerals; page No. by P; line No. by L, and column by col.

Inst. 1, 6/48. P 19, L 28, wide should read side. Ref. to Fig. 11, disked should read dished. P 20, L 11, perform should read preform. Letter "t," same paragraph, omitted in Figs. 8 and 9. P 22, L 24, reference letters A,B,C omitted in Fig. 15.

Inst. 2, 7/48. P 22, L 11, radial should read circumferential. Fig. 22, A and B transposed.

Inst. 3, 8/48. P 23, Fig. 26, symbols A,B,C—top, center and bottom respectively—omitted. P 24, L 9, view B should be C.

Inst. 4, 9/48. P 24, L 4, Inst. 3 should read Inst. 4.

Inst. 5, 10/48. P 25, Fig. 43, upper diameter increment should read 32, not 30. The material, shown as AC-250 and AC-350, should read Alcan 2S0 and Alcan 3S0. (This error also occurs in Figs. 114 and 116, Inst. No. 11, 4/49). P 26, Fig. 44, t/D ratios should read .40%, .40%, .10% at A,C and E.

Inst. 6, 11/48. Figs. 45 and 46 transposed right and left. P 28, L 3, (ref to Fig. 47) 15 in. blank should read 14 in.

Inst. 7, 12/48. L 8, col 2, ref to Figs. 56 and 57, both tools are double-action. P 37, Figs. 67, 68, 69, the caption should describe the extreme left as a draw-through type of tool, the center as a knockout type.

Inst. 8, 1/49. P 33, L 22, word Fig. 81 should read 82. P 35, L 18, drawing clearance should read drawing surfaces. Fig. 79, also Fig. 81, A and B omitted; identification of circles 1, 2, 3 omitted. P 36, L 6, machine should read mechanism. L 17, col 2, Fig. 87 should read 77.

Inst. 10, 2/49, should read: Inst. 9, and so on to conclusion of series, making 14 installments in all. P 35, L 20, formula incorrect, should read: $V = SPM \times C\sqrt{DY\text{-}Y^2}$. Table 7, open drawing speeds should read approximate. P 36, Fig. 89B, formula should read: $D = \sqrt{d^2 + 4dh}$-r. Fig. 91, symbols A and B omitted. In line 8, caption, R_1 should read R. Also, formulas for back and end radii should read, respectively: $D_2 = \sqrt{D^2 + 4Dh}$, and, $R_2 = D_2/2$; and: $D_1 = \sqrt{d^2 + 4dh}$, and, $R_1 = D_1/2$. Fig. 92, method of laying out blank should read: Draw a plan view of the shell, as shown, then draw a rectangle, the sides and ends of which are spaced a distance H from the shell outline. Line 8, caption, blank should read blend; in line 13, line 3 should read line e.

Inst. 11, 3/49. P 39, "die cavities", col 2, formula should read: $P = \pi(d_1^2\text{-}d_2^2)S/4$. Symbol for Pi was shown as 11.

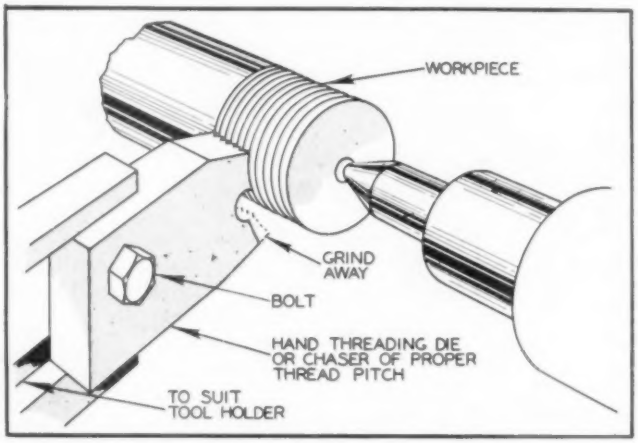
Inst. 12, 4/49. Fig. 104, symbols A and B omitted; same for Fig. 113. Fig. 115, A,B,C and D omitted. Fig. 117, mentioned in text, omitted because of close duplication. P 38, on specific data for clearance for Aluminum, 75% to 50% should read: .75% to 50%.

GADGETS

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

A "Converted" Threading Tool

A simple, effective and quickly made multiple-point threading tool, for threading duplicate parts on short production runs, can be made from the chaser of a threading die. Mount it solidly on a steel holder, as suggested by the sketch, with the shank end made to fit the lathe tool post.



Chasers from dies may be converted into threading tools for chasing threads on engine lathes.

The tool should be adjusted so that the leading—or slanting—face of the chaser lines up with the centerline axis of the work when located against its outside diameter. The setting will change with work diameter, as it is not necessary that the original die size be maintained. Only the proper pitch is essential and, generally, an oversize die will provide sufficient helix angle clearance.

In use, all regular threading procedure is used except that an exceptionally heavy feed between cuts can be used. The result is that an ordinary threading job can be done in just a few passes with a better finish on the threads. While not claimed to be ideal for high-class fits, the tool is a definite time saver for a wide range of threading jobs.

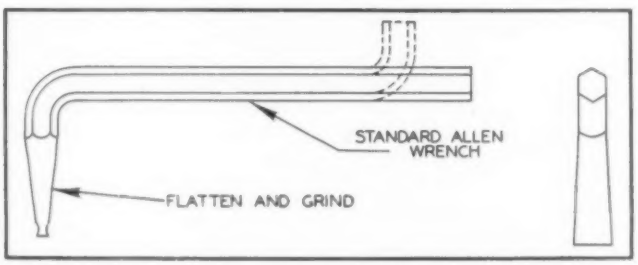
In lieu of a step-type die, as illustrated, a plain flat die can be used if held in a slot in a holder provided with a clamp plate to hold it in place.

Arthur R. Christensen
ASTE Member, Lockport, N. Y.

Hex Wrench Makes Handy Tool

A handy tool, for the gadgeteer, can be made from a standard hex wrench such as furnished for socket head screws. By heating and flattening the bent end, as shown, it will serve as an offset screwdriver for getting at hard-to-reach places. It can also be used as a pry-bar by placing a section of pipe on the long end, for leverage.

If so desired, the opposite end can be bent over, as suggested by the dot-and-dash lines; when so adapted, it serves the dual purpose of screw driver and wrench. Naturally, the temper will be destroyed when reworking; therefore, it should be reheated a cherry red and quenched to restore to original hardness.

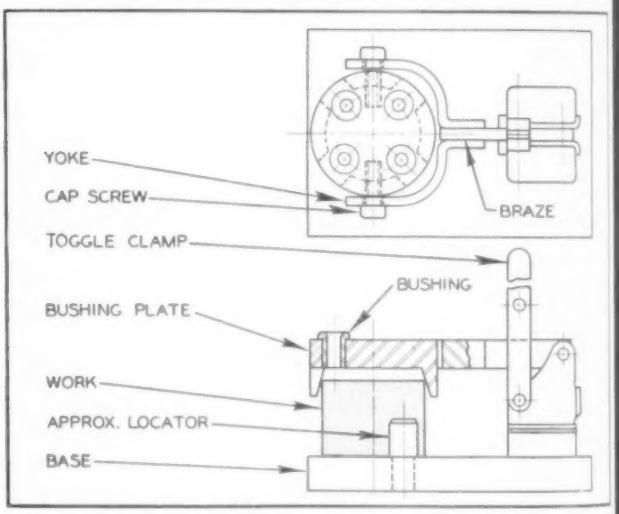


Allen or other socket screw wrenches may be converted into offset screw drivers or double end tools.

Roger Isetts
Kenosha, Wis.

Quick Acting Drill Jig

A quick-acting jig for accurately drilling holes in cylindrical parts can be readily and economically made, as illustrated. The bushing plate is made by using regular bar stock and boring a taper to fit over the O.D. of the work. Holes for drill bushings are bored in place. Four flats are milled through to provide chip clearance and allow the coolant to circulate freely. Two holes are bottom tapped directly opposite each other to accommodate standard screws.



With variations, the drill jig shown will serve for a wide variety of drilling on cylindrical parts.

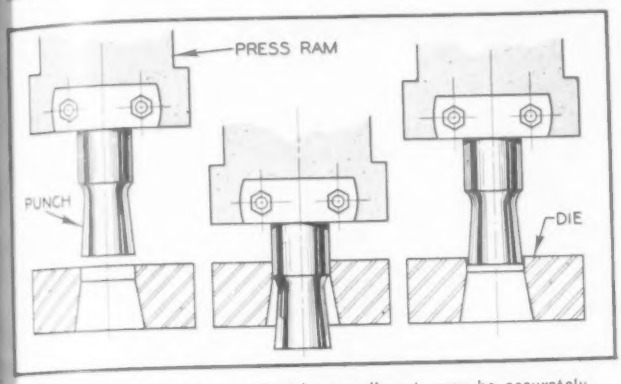
A standard toggle clamp is used, cutting the clamping bar short and brazing on a yoke, as shown, to straddle the bushing plate. Clearance holes in the yoke, for the cap screws, permit the bushing plate to locate itself on the work. Two pins, pressed into the base plate, act as approximate locators when loading the jig. This jig is loaded and unloaded very rapidly and has a minimum wear parts, thereby reducing repair and maintenance.

Stanley R. Welling
Racine, Wis.

The Tool Engineer pays regular page rates for accepted contributions to these pages, with a minimum of $5.00 for each item.

To Align Punches and Dies

A simple but often overlooked method of accurately aligning punches and dies when not mounted in a die set is herewith illustrated. Make the cutting edge of the punch to proper clearance for the stock to be worked, and taper it back slightly for clearance, as shown exaggerated in the sketch.



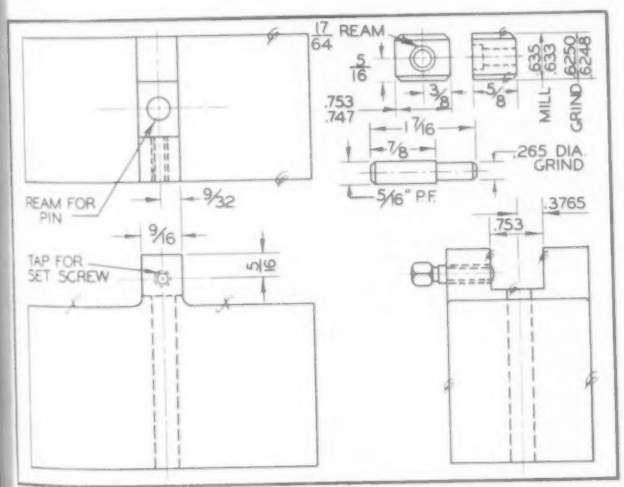
Punches and dies, when used without a die set, may be accurately centered by the means illustrated. Back taper of punch is exaggerated.

Above this point, make the body of the punch about 0.0002 in. smaller than the die opening, and with a lead-on as shown. Lowering the ram until the punch is well in the hole, as shown at center, aligns the punch perfectly. After bolting the die in place the ram is raised into proper cutting position, as shown at right.

John Turvene
Dallas Chapter, ASTE

Simple Straddle Milling Fixture

Typical of simple tools is the straddle milling fixture for a spindle drive key, such as shown at upper right. The key is cut to length and milled, then drilled and counterbored in a later operation. The sides are milled symmetrical from the center line of the hole, and later ground after hardening.

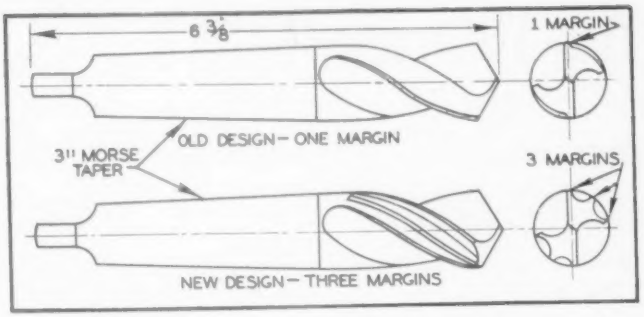


The simple milling fixture shown facilitates milling of machine tool keys.

The block used for straddle milling has a hole central with the tongue, into which a pin is inserted, drive fit. The smaller diameter fits the hole in the workpiece. After locating, the parts are clamped by means of the screw shown at the front of the clock. The block in turn is held in a milling machine vise.

Robert Mawson
Providence, R. I.

Redesigned Drill Adds Tool Life



Redesign of a drill to incorporate multiple margins increased tool life, decreased grinding and practically doubled output.

A severe interrupted drilling job on the ears of steel yoke forgings caused the old-style drills with single margins—upper illustration—to break down rapidly. Consequently, the grinding department had to cut off a considerable length of the drills to recondition them for use.

By using a drill designed with three margins, as shown in lower illustration, we obtained more bearing with increased tool life. The change almost entirely eliminated the cutting off which, previously, had been necessary to keep the drills in service. Grinding time was reduced about 60 percent and output practically doubled.

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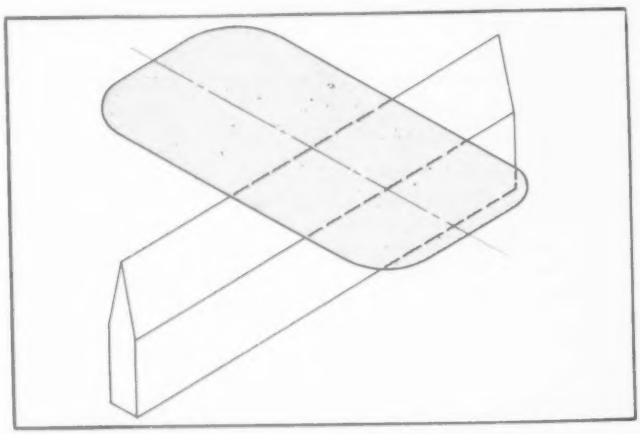
Saginaw Steering Gear Div., GMC
Saginaw, Mich.

To Determine Center of Gravity

A simple way to find the center of gravity of irregularly shaped parts, without involved calculations, is to lay the part on a knife-edge straight edge. After ascertaining equilibrium in one plane, turn the part 90 deg for balance in the opposite direction.



By balancing odd shaped parts on a knife-edge, first in one plane and then at right angles, and scribing lines coinciding with the knife-edge, one obtains a close approximation of the center of gravity. The point is at the intersection of the scribed lines.

In each case, scribe a line coinciding with the knife edge of the straight edge, and the intersection of the lines so scribed will be the center of gravity of the part. Should only a parts drawing be available, rather than the actual part, then the results can be obtained by cutting out a cardboard model and balancing that as described. In most cases, the result will be close enough for all practical purposes.

Federico Strasser
Santiago de Chile.

THE TOOL ENGINEER'S *Service Bureau*

FREE BOOKLETS AND CATALOGS CURRENTLY OFFERED BY MANUFACTURERS

Alloy Data, Copper

Data and procedure information issued periodically in sheet form designed to be added to special binder, available on request, for permanent reference. *Cerro de Pasco Copper Corp.*, 40 Wall St., New York 5., Cerro Alloy Application Data File."

Alloy Irons

Twenty-six page illustrated brochure presents description, mechanical properties and recommends uses for various types of Domite alloys. *Dominion Wheel & Foundries Ltd.*, Toronto 2, Ontario.

Bearings

Twenty-four page brochure presents complete size lists for sleeve type, flanged type thrust washers and bar stock in addition to illustration and description of self aligning and special shaped bearings and data on standard tolerances. *Bound Brook Oil-Less Bearing Co.*, Bound Brook, N. J.

Camber (Edge) Control

Two-page leaflet describes construction and operating features of automatic guiding and positioning control for continuously moving strip. Includes schematic and wiring diagrams plus installation photos. K-2051, *Reliance Electric & Engineering Co.*, Cleveland.

Chuck, Power-Grip

"Magnetic Holding Methods" contains illustrations, descriptions and data on recently redesigned power-grip Viking chuck, including information on applications to milling, planing and grinding operations. *Rockford Magnetic Products Co., Inc.*, 1302-18th Ave., Rockford, Ill.

Cylinders

Describes cylinder designed for operation with air, water or hydraulic power. Booklet features drawings and cross-sectional diagrams plus charts of dimensional data for various mounts. *Ortman-Miller Machine Co., Inc.*, Hammond, Ind.

Drilling, Boring, Tapping Units

Contains information on Model C floor type units plus tables on spindle speeds, data on adjustable and slip type spindles and complete specification charts. Bulletin 848, Dept. 42, *National Automatic Tool Co.*, Richmond, Ind.

Fasteners, Steel

Illustrated Catalog No. 49 gives dimensional tables for full line of stainless steel fasteners plus reference data on corrosion resistance, stainless performance characteristics, hardness conversion etc. Indexed for quick use. *All-metal Screw Products Co., Inc.*, 33 Greene St., New York 13.

Gas Burners, Industrial

More than 60 types of burners in 600 sizes shown, as well as high and low pressure equipment: contains practical information on selection considering services and various gaseous fuels; also engineering data on furnace design and input requirement calculations. *Surface Combustion Corp.*, Toledo 1, Ohio.

Jigs and Fixtures

Illustrated to show product in use, 150-page catalog No. 7 is separated into five sections describing spring jigs, rack and pinion jigs, rapid clamps, fixture details and fixture rack. *Siewek Tool Co.*, 2862 E. Grand Blvd., Detroit 2.

Lathes

Sixty-five page catalog No. 100-G presents description and specifications for line of toolroom, quick change gear, metric, plain change gear and turret lathes, drill press and bench shaper; including information of attachments and accessories. *South Bend Lathe Works*, South Bend 2, Ind.

Measurement, Angles

Booklet describes Webber angle gage blocks, calculated to give accurate angle measurement to millionth part of a circle. Diagrams explain how angle blocks can be wrung together to inspect angles in degrees, minutes and seconds. "Angle Inspection, A New Improved Method", *Webber Gage Co.*, 12900 Triskett Rd., Cleveland 11, Ohio.

Metal Primer, for Paint

Leaflet, "Don't Blame the Paint—the Trouble is Underneath", describes Ospho, metal primer applied over rusted surfaces. Give advantages, uses and price list. *Rusticide Products Co.*, Perkins Ave., Cleveland 14, Ohio.

Milling Machines

Catalog M-1662 combines description of company's 2ML and 2MI milling machines for easy comparison; includes general specification charts and dimensional drawings. *Cincinnati Milling & Grinding Machines, Inc.*, Cincinnati 9.

Pressed Powder Parts, Nonferrous

First of quarterly 4-page bulletins, "Metal Powder Press" presenting case histories on nonferrous pressed powder parts; illustrated. Copies available to executives, designers, engineers. *New Jersey Zinc Co.*, 160 Front St., New York 7.

Presses, Bench

Bulletin No. 251 describes Series "M" air operated bench presses for increasing light production operations; includes table of installation dimensions and specifications. *Hannifin Corp.*, 1119 So. Kilbourn Ave., Chicago 24.

Rectifier, Electronic

Bulletin K-2125 describes full-wave Reliance VSX rectifier for spot conversion application; adaptable to variety of auxiliary power services where precision filtering and ripple voltage heat losses not critical. *Reliance Electric & Engineering Co.*, 1076 Ivanhoe Rd., Cleveland 10, O.

Stamping

"Simplify Your Production with Advance Tooling" describes facilities and equipment of company specializing in complicated dies and tools for sheet metal drawing and forming. *Advance Die & Tool Co.*, 6800 Madison Ave., Cleveland 2, O.

Steels

Indexed booklet describes stainless and heat resisting, tool and die, and cast-to-shape steels; analysis and typical applications outlined for each type. "Specialty Steels", *Jessop Steel Co.*, Washington, Pa.

Tester, Universal

Bulletin M gives pictures and detailed description of equipment and operation of multi-low-range tester for paper, fabrics, plastics, leather, wire and most other light material. *W. C. Dillon & Co., Inc.*, 5410 W. Harrison St., Chicago 44.

Tools, Metal Cutting

Eight-page circular, Form 51, illustrates line of drills, reamers, carbide tools, etc., including list numbers. *Chicago-Latrobe*, 411 W. Ontario St., Chicago 10.

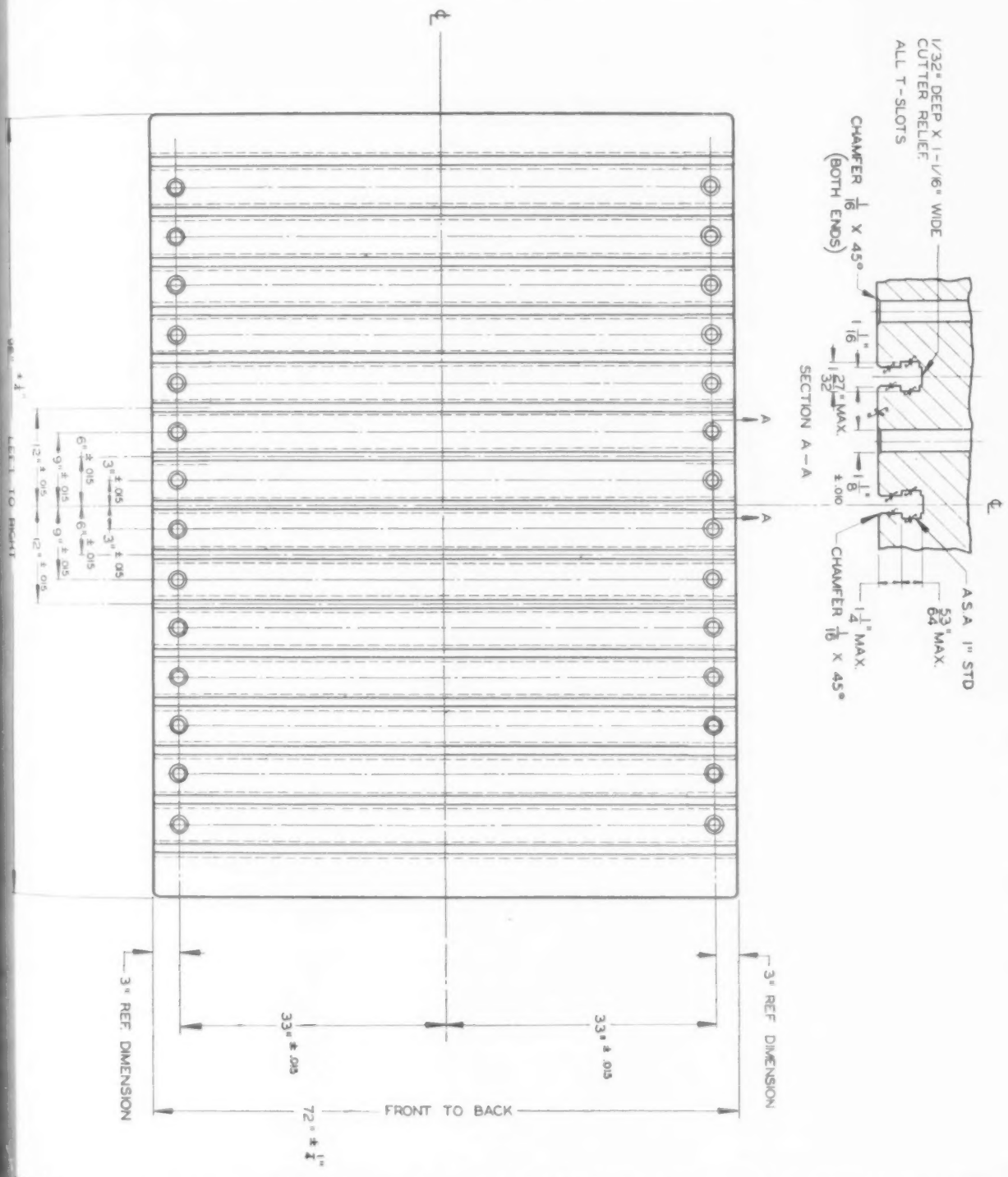
TOOL ENGINEERING DATA

NUMBER SEVEN

J. I. C. Standard Press Dimensions

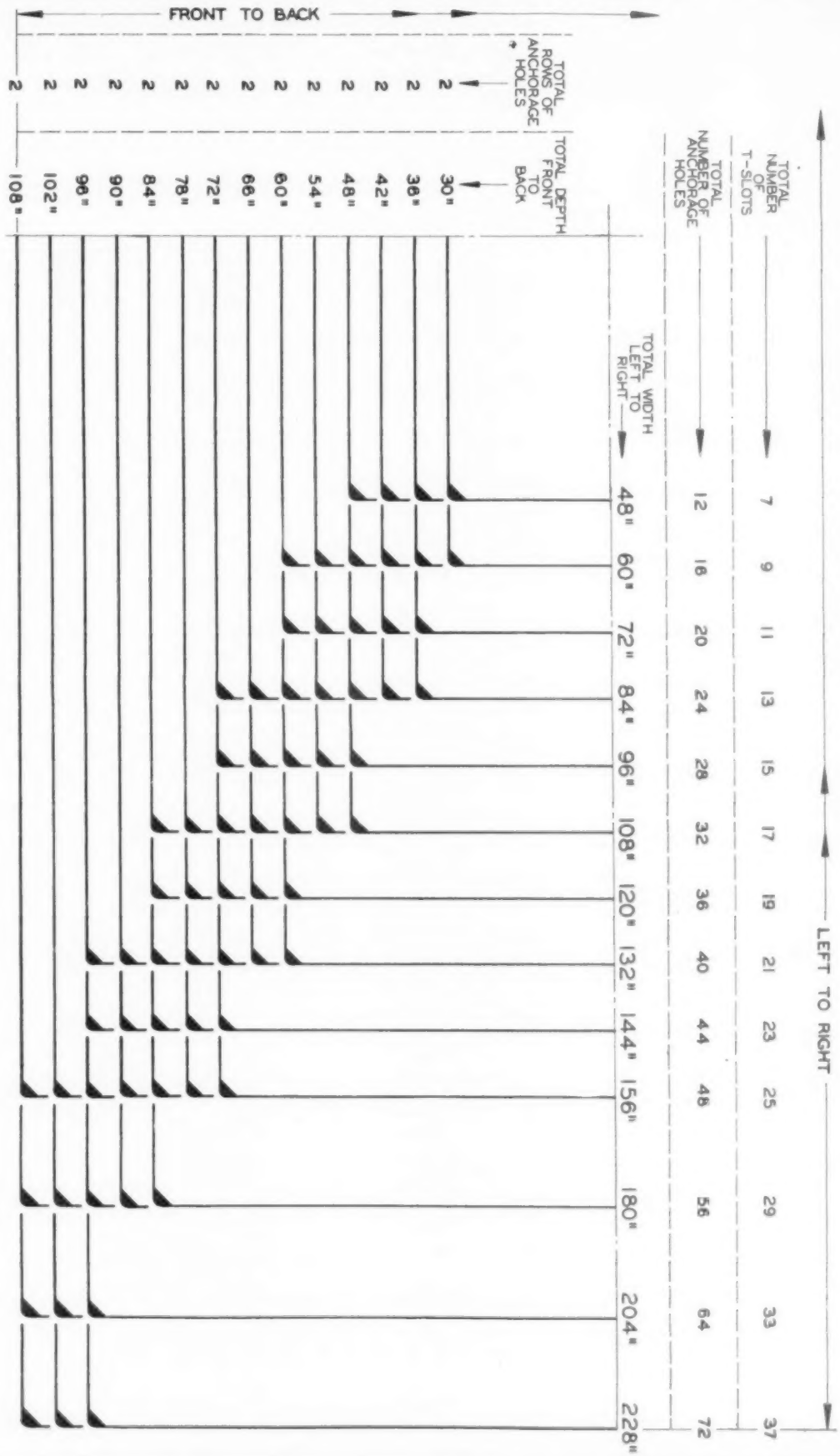
Single Action — Multiple Point Press — Ram

UNIFORM SPACING OF ANCHORAGE HOLES AND T-SLOTS (Representative Sample)

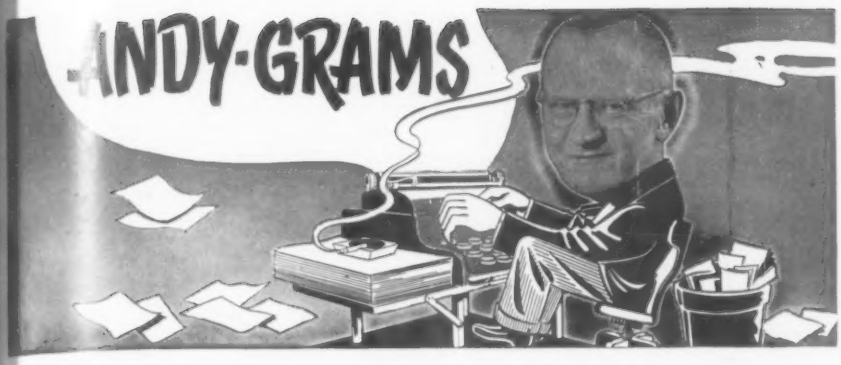


The above suggested standards have been adopted by the Joint Industry Conference, a group comprising representatives of press manufacturers and users, in the interests of dimensional standardization and more effective press usage.

J. I. C. STANDARD PRESS DIMENSIONS • SINGLE ACTION—MULTIPLE POINT PRESS CHART OF RAM SIZES • TOTAL NUMBER OF T-SLOTS ANCHORAGE HOLES LEFT TO RIGHT AND TOTAL ROWS OF ANCHORAGE HOLES FRONT TO BACK


FRONT TO BACK
TOTAL ROWS OF ANCHORAGE HOLES
TOTAL DEPTH FRONT TO BACK
TOTAL WIDTH LEFT TO RIGHT
TOTAL NUMBER OF ANCHORAGE HOLES
TOTAL NUMBER OF T-SLOTS
LEFT TO RIGHT
2 30" 48" 12 7
2 36" 60" 16 9
2 42" 72" 20 11
2 48" 84" 24 13
2 54" 96" 28 15
2 60" 108" 32 17
2 66" 120" 36 19
2 72" 132" 40 21
2 78" 144" 44 23
2 84" 156" 48 25
2 90" 180" 56 29
2 96" 204" 64 33
2 102" 228" 72 37
108"

ANDY-GRAMS



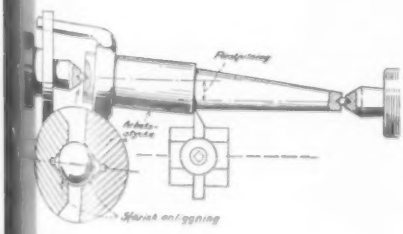
The weather being conducive to reverie rather than to action, I'll just put down thoughts—if any—as they come to me at the moment is a blank mind. Blank, and therefore open to any inspiration as long as it doesn't involve the ordeal of thinking. Now, having jockeyed for an opening, we'll ramble along.

Right away, an inspiration popped up in the person of Doc Nelson, erstwhile wheelhorse at HQ but now a gentleman farmer out Ann Arbor way. That's the life! The conversation turning to rabbits, crows and other critters, I gave him pertinent advice based on my intimate (?) knowledge of nature, viz: Don't kill hawks, owls, skunks and harmless snakes etc they hold down pests besides which some of 'em make interesting pets. Also, I told him to get a couple of goats which will eat a lawnmower all hollow and make the grass grow besides. Remember that if you go farming.

Next, a leter from Norman Martin, formerly of Detroit but now a resident of Long Beach, California, with news of *old acquaintance* including what he terms an arch enemy. Didn't know I had any, but if so it's one sided. Me, I like everybody . . . well, everybody that's on the level. Anyway, Norm is writing a book on the trials and tribulations of tool designers which should net a sympathetic readership.

Glancing through the current number of *Verkstaderna* (Stockholm) I see where H. J. Chamberland—who recently had a similar article in The Tool Engineer—had contributed a story on bandsawing to that magazine. Also ran across a "gadget" which I'll pass along, for once putting it in the Column a/c it's a "steal" although I'm sure Dir. Goransson and Editor Haggstrom won't mind since they're privileged to lift from us if so minded, with credit to the source. Hands across the seas, y'know.

As for the Gadget, the illustration is so obvious that only superficial elaboration is necessary. But as you know, the regular 60° lathe centers go out of alignment when turning tapers by offsetting the tailstock, so here they interpose steel balls which not only provide spherical centers both ends but also reduce heat ordinarily generated by friction. For your info, *forskutning* means offset, *arbetsstycke* workpiece, and *sfarisk anliggning* spherical contact—I hope. Anyway, ask Jake Demuth or Roger Waindle—they'll know.



Speaking about foreign publications, we get 'em from about all over except Russia; there, everything goes in and nothing comes out except claims that they got there first. (Wonder what's Kilroy's nationality?) Anyway, we manage to get the meat from most of 'em, thanks to my linguistic ability gained via crossword puzzles and the French I learned in Woonsocket. And there's a reminder!

As the saying goes, it's a small world, apropos which a brief get-together with Ray Morrissey at a Chapter meeting brought out that we'd both worked at Taft-Pierce's back in '15 or so. Seems that mutual acquaintances includes about everybody Who was Who in Woonsocket at the time. As I got it, Ray served his apprenticeship at the American Optical Works, Southbridge, Mass., which brings up a story or two.

Among my buddies at Pratt & Whitney's around 1910—and later at T-P—was a young toolmaker whom I'll call Simon Simonson. His first job, after coming over, was as a bench hand at the Optical Works. There, tobacco chewing was taboo—no mention of *snus*—but, forbidden fruit having its appeal, the ban was generally disregarded. Just so you didn't get caught.

Si had just got his cud molded to his cheek, one balmy day, when the foreman breezed in. Si promptly heaved the cud out through the open window—plop on the head of the Old Man, just passing by. Tableau! Later, feeling his oats one evening, he decided on a joy ride, no doubt inspired by a horse and buggy hitched along the main stem. Due to his limited English, he got his commands mixed up; instead of "giddap" he said "back up" and the horse did—right through a plate glass store front!

Coming back to Ray Morrissey, I tried to visualize him with a mop of hair and sans mustache, thereby placing him among my acquaintances of thirty odd years ago. Then, at a casual mention of Charley Arnold, late toolroom foreman at T-P, the wheels of memory began to click. I recall a remark made by Charley and concerning Ray: "One thing about that boy is that, right or wrong, he has the courage of his convictions."

Among qualities that I admire in a man are guts and honesty which, combined, imply the moral courage to do the right thing, even at risk of criticism. And from what I've seen and heard of Ray, he seems to have those qualities to a marked degree.

Apropos another saying that "still waters run deep," Andy Carnegie of Detroit is looming on the Society horizon as one of the men of the hour. Quiet and modest—he's not one to toot his own horn—Andy has nevertheless evinced a flair for constructive leadership that, in time, should project him into the upper ASTE bracket. Good men can't be allowed to hide their lights under bushel baskets.

Over the coffee, at Detroit's June meeting, I swapped fish stories with E. R. DeLuiz, old timer who, once a Director and a prime mover in the Society, is now a bleacherite like myself. Revisiting old scenes, we travelled from Casco Bay to Point Judith, fishing as we went but with Ed always a jump ahead. If I caught a 15 lb. tautaug he pulled in a 20 pounder, and so on. Thought I had him stopped when I told about pulling in a 5 ft. shark, but demme if he didn't land three whales off Swampscott. There being no bigger fish (?) I gracefully proclaimed him the bigger li—uh, I mean, the better fisherman.

Now, I'm not one to brag about my fishing, anyway not with my better half sure to read these lines. She knows! But, we'd gone out for a cooling off at one of the Oakland County lakes, a few years ago, in company with a cousin not too long over and who'd been a professional fisherman on the other side. And, pun or no pun, he knew the angles; what he didn't know was that the lake was just about fished out. Anyway, he tried, so, in after a swim, I walked over to where he was patiently watching his float near a patch of weeds. Just as I got near him a big green grasshopper came whirring by, and I reached out and caught it.

"How's the fishing?" "Not so good;" glumly, "just nibbles." "Oh? Trouble is, Gus, you ain't used to American fish. Here, let me show you." So, taking the pole, I surrepticiously slipped the grasshopper on the hook and let her go. And, believe it or not, the hook had barely touched the water when whoosh!—a whopper of a bass hit so hard that I landed him on the pull-back. "There, Gus, that's the way we do it in America." With that, I handed back the pole and beat it lest my look of amazement—and you should have seen *his* face!—be a dead giveaway. Gus went back a few years ago, so I'm going to mail him a tear sheet of this as a reminder of the occasion. And now, hoping that the clouds on the horizon portend rain I am

Warmly yours

Andy

First Society Handbook Dedicated to Industrial Progress

Manual Representing Five Years' Effort of Thousands Is Published This Month Embraces Entire Field of Metalworking and Allied Manufacturing Processes

CONSERVATIVELY ESTIMATED at $1,000,000 is the "know-how" packed within the more than 2000 pages of the "Tool Engineers Handbook" being released by the publisher late this month.

The result of five years' work of the Society's Handbook Committee and thousands of engineering experts and metalworking authorities, it comes to ASTE members for the nominal sum of $11.

It is the first time such a fund of tool engineering information has been made available in one source. In many cases it is the only written source of sorely needed reference material. Where no data existed, research and surveys have been conducted in order that no phase of the profession would be left to trial and error.

As an example of industry's enthusiastic collaboration, one company estimates that it spent $2000 in writing and drafting time for just one section of the Handbook. Manufacturers recognize that such investments will be amortized in savings through application of the overall production knowledge contained in this book.

Gives T. E. Confidence

To the individual tool engineer it is even more valuable—it will expedite the handling of any tooling assignment for fabricating metal and other materials. With it he can profit by others' experience, correct his mistakes, and avert trouble before it occurs. This one handy volume will eliminate bulky files of slowly accumulated private data.

Classified under eleven main headings, the 115 sections cover everything from planning through inspection. Approximately 2000 tables, charts, diagrams, drawings and nomographs illustrate and augment the text. Nearly 50 pages are required to list some 9000 entries in a comprehensive index. A list of section titles, a typical page, and a sample of the index are shown on the next page.

President R. B. Douglas opens sale of the Handbook by writing check for first copy as E. W. Ernst, Handbook chairman, looks on.

Measuring six by nine inches, the book is convenient in size and durably bound in blue flexible Fabricoid. Gold stamping on the front cover and spine carries out the Society's colors.

The thoroughness with which subjects have been covered is apparent in a breakdown of the 245 distinguished authors and editors from: 50 manufacturers in key industries, 11 technical societies and publications, 35 universities and consulting engineers, 51 machine tool manufacturers, 28 cutting tool manufacturers, 47 special equipment producers, and 23 materials producers and processors.

These contributors were assisted by countless specialists on their staffs and the resources of their respective organizations.

Besides this, McGraw-Hill Book Co., publishers of the Handbook, have freely offered their facilities and technical publishing experience. The heavy investment in standing type, artwork and engraving alone would hamper the operations of many publishing houses.

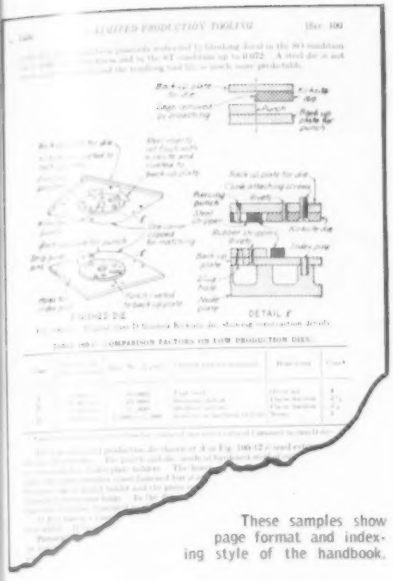
But the burden of the book has fallen most heavily on the Handbook Committee and the editor, through whom every bit of material has been cleared, checked, often returned to the author for revision, rechecked, submitted to reviewers, and proof read in type.

Same Committee Throughout

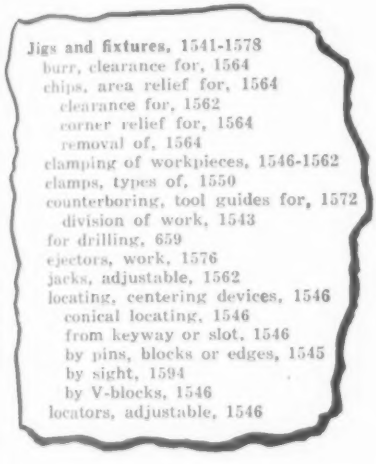
Ever since the committee was appointed in 1944, shortly after the Handbook was first conceived, it has had the same members with a few additions as the volume of work increased.

Chairmanned by E. W. Ernst, superintendent, Punching, Tool and Die Div., General Electric Co., Schenectady, N. Y., the original committee consisted of R. B. Douglas, president, Godscroft Industries, Ltd., Montreal, Que.; Frank Martindell, development engineer, Teletype Corp., Chicago, Ill.; Frank W. Curtis, consulting engineer, Springfield, Mass.; and Adrian L. Potter, assistant general manager, Eastern States Exposition, Springfield, Mass.

In January of 1945 Frank W. Wilson, former copy chief of the Catalog and Directory Div., McGraw-Hill Publishing Co., New York, joined the ASTE headquarters staff as editor of the Handbook. The painstaking work of organizing and cataloging material as it was received was executed by Mr. Wilson and his assistants.



These samples show page format and indexing style of the handbook.



Jigs and fixtures, 1541-1578
burr, clearance for, 1564
chips, area relief for, 1564
clearance for, 1562
corner relief for, 1564
removal of, 1564
clamping of workpieces, 1546-1562
clamps, types of, 1550
counterboring, tool guides for, 1572
division of work, 1543
for drilling, 659
ejectors, work, 1576
jacks, adjustable, 1562
locating, centering devices, 1546
conical locating, 1546
from keyway or slot, 1546
by pins, blocks or edges, 1545
by sight, 1594
by V-blocks, 1546
locators, adjustable, 1546

As manuscripts began to come in, B. C. Brosheer, associate editor, *American Machinist*, Chicago, Ill., and Harry Crump, chief tool sales engineer, Carboloy Co., Inc., Detroit, Mich., were added to the committee.

Together this group has established a record for sustained effort on a single Society project.

All This and More in the Handbook

Tool Engineering Economics and Application ***(Sections 1-12)***

Tool Engineering, Product Development, Tool Engineering Economics, Production Analysis and Cost Estimating, Job Planning and Control, Quality Planning and Control, Time Study and Rate Setting, Control of Small Tools and Gages, Plant Layout, Materials Handling, Codes and Numbering Systems, Drafting Room Practices

Materials and the Tool Engineer ***(Sections 13 - 27)***

Structure and Properties of Metals, Heat Treating, Metal Cutting and Machinability, Induction Hardening, Metalworking, Fluids and Compounds, Woods, Plastics, Plastics Forming; Sand, Investment, Metal Mold and Plaster Mold Casting; Powder Metallurgy, Extrusion of Metals

Production Processes, Equipment and Tooling ***(Sections 28 - 75)***

Processes Using: Cutting Tools, Abrasive Tools, Forming Tools and Dies, Gas and Electricity

Assembly Methods ***(Sections 76-86)***

Gas Welding, Arc Welding, Resistance Welding, Soft Soldering, Brazing; Bolts, Screws and Rivets; Wire Stapling and Stitching, Shrinkage Fits, Gluing, Dielectric Heating, Plastic Joining

Miscellaneous Manufacturing Operations ***(Sections 87 - 89)***

Surface Cleaning and Protective Finishing, Shot Peening, Static and Dynamic Balancing, Liquid Honing

Inspection, Testing, Fits and Tolerances ***(Sections 90-95)***

Standard Systems for Cylindrical Fits and Limit Gaging, Allowances and Tolerances for Cylindrical Fits, Inspection Equipment and Methods, Non-Destructive Testing and Inspection, Surface Roughness and Quality, Mechanical Tests and Equipment

Production Cutting Tools ***(Section 96)***

Single-Point Tools, Form Tools, Drills, Broaches, Countersinks, Counterbores, Spot Facers, Deep Hole Drills, Solid Taps, Solid Reamers, Carbide Reamers, Milling Cutters, Shaper Cutters, Hobs, Inserted Blade Reamers and others

Tooling Design Practice ***(Sections 97-100)***

Punches and Dies, Jigs and Fixtures, Master Tooling, Limited Production Tooling

Machine Drives and Controls ***(Sections 101-103)***

Hydraulic Equipment, Pneumatic Equipment; Electronic Drives, Controls

Machine Parts and Mechanical Elements ***(Sections 104-112)***

Screw Threads, Gears, Splines and Serrations, Cams, Ball and Roller Bearings, Sleeve Bearings and Bushings, Springs; Keys, Shafts; Tapers and Spindle Noses

Tool Engineering Science and Mathematics ***(Sections 113-115)***

Mechanics and Physics, Mathematics, Reference Data

According to an advance publication announcement by Executive Secretary H. E. Conrad, each member is entitled to one copy of the Handbook at the special price of $11. Additional books may be purchased at the $15 list price.

Special arrangements are being made to facilitate deliveries in Canada and elsewhere outside the United States.

To be sure of having the first edition as soon as it comes from the bindery, mail the order coupon at the right today.

Here's My Order

Please send my copy of the "Tool Engineers Handbook" to the address below, at the special, ASTE member price of $11.

Name ..... Chapter .....

Business Title ..... Firm Name .....

Street Address .....

City ..... Zone ..... State .....

Remittance payable to the Society must accompany order. Do not send currency. Mail this order coupon or a facsimile to: American Society of Tool Engineers, Dept. 7, 10700 Puritan Ave., Detroit 21, Mich.

Important—In order to obtain the $11 price, orders must be sent to the Society.

Names Six Factors Vital To Successful Product

Poughkeepsie, N.Y.—Six steps are necessary for a successful product, R. W. Coolbaugh, chief product engineer of the Easy Washing Machine Corp., Syracuse, N. Y., told a joint dinner meeting of Mid-Hudson chapter, ASTE, and the American Society of Quality Control.

Approximately 80 members and guests heard Mr. Coolbaugh's lecture, "How Successful Engineers Use Quality Control," at the Nelson House, May 10.

The six major phases the speaker named as: (1) consumer research; (2) product research and development; (3) design specifications, improved through quality control experience; (4) manufacturing; (5) quality control; and (6) performance research.

The last point was emphasized by the speaker as vital to the manufacturer's success in satisfying his market.

Quality control, he stressed, is neither parts rejection, a synomym for inspection, nor a cure-all. It is rather the collecting and interpretation of production information for formulating conclusions and predictions.

This data becomes a basis for improvement in quality and reduction in cost. Design errors can be minimized by utilizing such records. The quality control engineer can assist also in materials purchases by checking parts prints with the design engineer before submitting them to the vendor for quotation.

Mr. Coolbaugh supplemented his talk with slides and blackboard diagrams.

Prior to Mr. Coolbaugh's address Frank Jacquemard, vice-chairman of the local ASQC chapter, gave a coffee talk, "What Is Quality Control?" His answer defined quality control as a new way of thinking based on statistics.

Joseph L. Petz, chairman of the ASTE group, presided.

Our Society

By Harry E. Conrad, Executive Secretary, ASTE

We are now going through the second half of our postwar economic adjustment. The first half—rebuilding civilian production and attempting to allay part of a tremendous consumer demand—has occupied our attention since the war. Now we are engaged in the even tougher part of the job; we must bring manufacturing costs in line with the earning power of the great masses of our people.

This enforced lowering of costs is a must in industry today, and in importance it outshadows all the past accomplishments of tool engineers. At the same time, it is a problem that only the tool engineer can do much about.

Lowering manufacturing costs to bring them into line with the consumer's ability to pay is not a job that is going to be done overnight. It is going to require the maximum of study and adaptation of more efficient methods, designs, machines and tools. It will inevitably bring with it economic dislocations, shifts in employment, some hardships—and many new opportunities. Many tool engineers, if not most, will have the chance to do that job in the plants with which they are now associated. Others are going to be called to new fields.

Regardless of where he will do his part of the national job, there is a terrific shortage of tool engineers for that job. Members of ASTE have a major responsibility in this regard: making the most effective use of available tool engineering manpower.

Tool engineering as a profession implies a cooperation among members of the profession; an exchange of ideas and a striving for the betterment of the profession. Thus membership in ASTE and attendance at chapter meetings take on a new importance. There is no other meeting ground, no other forum, that can mean so much to the tool engineer today as ASTE and his chapter meetings.

The time the tool engineer devotes to his professional organization, in national and particularly in chapter activities, is an investment that pays off both in short term and in long-term gains. Not only does alliance with members of his profession enhance the prestige of the profession, it enhances the prestige and provides greater personal opportunities for the individual tool engineer. His dividends in ideas are considerable in themselves, but even more important are his contacts with other members of the profession which offer him concrete help in professional advancement. It is difficult to underestimate the value of such contacts at any time, and particularly in periods of economic readjustment.

It's just a matter of taking advantage of these opportunities.

Says Private Negotiating Best for Labor, Industry

Madison, Wis.—There is a fundamental difference between the labor movement in America and in Europe. On this side of the Atlantic the tendency has been toward collective bargaining where people are job conscious. Abroad labor tends to center in a political party which endeavors to handle the whole labor relationship through legislation.

Results of the latter method, according to R. W. Fleming, director of Industrial Relations Center, University of Wisconsin, indicate that maximum benefit would be obtained with a minimum of legislative restriction.

Otherwise, said Mr. Fleming, speaking before a meeting of Madison chapter May 10, at the Park Hotel, labor laws would be contingent upon the party in power. Whereas better results for all concerned could be evolved in settlements between individual unions and companies.

Mr. Fleming also reviewed the growth of organized labor from the craft unions under the American Federation of Labor through the NRA, Wagner Act, formation of the CIO, and the Taft-Hartley Act. His discussion included an outline of labor codes developed in Europe before World War II and in South America where relationships between capital and labor are defined in detail.

J. J. Demuth, second vice-president of ASTE, was a guest at the meeting and spoke on Society history and aims.

Other News in This Issue

Chapter	Page	Chapter	Page
Atlanta	64	New Haven	55
Boston	64	Philadelphia	68
(Bridgeport) Fairfield County	55	Pittsburgh	68
Cedar Rapids	57, 64, 66	Pontiac	57
Chicago	57, 60	Portland (Me.)	57
Cleveland	63, 66	Rochester	62
Columbus	66	Rockford	65
Denver	57	San Diego	66
Detroit	60, 62, 66	(San Francisco) Golden Gate	67
Erie	67	Seattle	62
Evansville	60, 67	Springfield (Mass.)	67
(Flint) Saginaw Valley	60	(Springfield, Vt.) Twin States	68
Fort Wayne	57	(St. Charles, Ill.) Fox River Valley	57
Hamilton	67	St. Louis	64
Hartford	55, 57	Toledo	66
Houston	57	Toronto	60
Kansas City	56	(Utica, N. Y.) Mohawk Valley	60
Los Angeles	63, 66	Windsor	65
Louisville	68		
Milwaukee	62		
Montreal	58, 66	Coming Meetings	68
Muncie	60	Obituary	68
(Newark) Northern New Jersey	56	Situations Wanted	60

Chapter listings include member as well as meeting news.

Industry Took Initiative in Atomic Bomb Development When Scientists Floundered, General Groves Reveals

Waterbury, Conn.—Private industry can take much of the credit for shouldering the practical development of the atomic bomb after the scientists had bogged down in indecision. And before the Russians can produce such a bomb, they will have to adopt the American free enterprise system, in the opinion of the engineer responsible for the manufacture and delivery of the nuclear fission missile.

Addressing about 380 members of Fairfield County, Hartford and New Haven chapters and guest industrialists at Hotel Elton, May 20, Lieutenant General Leslie R. Groves, now director of the Remington-Rand laboratory for advanced research at South Norwalk, unfolded much of the untold story of the bomb. The "Connecticut Night" dinner meeting was the first state-wide gathering of the three ASTE chapers.

A. H. d'Arcambal (right) general chairman of "Connecticut Night" meeting of three ASTE chapters, introduces the speaker, Lt. Gen. Leslie R. Groves (center), who revealed problems in directing atomic bomb production, and Harry E. Conrad, ASTE executive secretary.

"When all the stories come out, some of the foremost scientific reputations in the country will topple," the retired army man said in revealing for the first time details of the internal conflict in the Manhattan Engineering Project.

Germans Working on It

When the nation started to arm for the second world war, General Groves was placed in charge of the construction of all military installations. About then some scientists convinced Bernard Baruch that Germany might make an atomic bomb. After Professor Albert Einstein had confirmed this, Mr. Baruch presented the matter to President Roosevelt.

A small Navy appropriation was designated for research. Some 18 months later President James B. Conant of Harvard headed the atomic energy commission. In the summer of 1942 General Groves was assigned to the project. His primary job was to determine the plants, machinery and equipment needed for producing the bomb, even before the theory had been perfected.

"Used to engineering tolerances of, say, three thousandths of an inch, I was told by these people that a factor of from one to 10 was involved in their equations," he said, "so that if the amount of uranium for the bomb were to be the hypothetical figure of 10 pounds, it could weigh anywhere from one to 100 pounds. With this information, I was supposed to get ready for production."

Viewpoints Differed

This was typical of the general's experiences with the pure scientists doing the theoretical work. Approaching the problem from opposite poles, they had little in common.

"As an engineer, I was well aware of all the myths of the Middle Ages when people were trying to transmute baser metals to gold. I was considerably shocked when I was told that the objective in the University of Chicago laboratory was transmutation—changing uranium into plutonium. My confidence was not increased when I found that in going from one equation to another the scientists were not so good at algebra and simple arithmetic.

"I was also introduced for the first time," he continued, "to blackboard security. When I asked if the theory were written down anywhere, they said it was too secret and the blackboard was erased every night. Of course, this made it possible for you to say something entirely different the next day and deny what you had on the blackboard the previous day."

The first major hurdle was a "simple problem in metallurgy," the general said. "It was to move the uranium gases along a system of tubes, several hundred miles long, and through a barrier material—a process commonly known as a cascade system. The end result was to be the pure substance—uranium 235."

Since separating isotopes by gaseous diffusion methods was to be the basic operation of the $450,000,000 Oak Ridge plant, the general had to learn the nature and operation of the barrier material before construction of the plant could begin.

"Eventually," he said, "the entire plant was designed on the basis of 'a small piece of material the size of a silver dollar.' It was a very low rate of separation based on the difference in molecular velocity of the material going through the barrier."

The physicists kept insisting that the barrier would be solved within a week or two, but made little progress. Meanwhile a Detroit industrial designer was waiting patiently for the solution so he could start designing the Oak Ridge plant.

"Finally," General Groves said, "we had the huge horseshoe plant completed before the barrier was solved. The solution came literally at the very last minute."

Made Decision on Cooling Methods

In the cooling process he met a similar situation. "This is very important," he said. "You've got to have the gas hot enough to do the work you want, yet cool enough to keep it from leaving the country." When he asked how the cooling would be handled, he was told there were six general methods, with variants. After a 15 minute conference in Chicago, he boiled these down to three.

Separation tests at the Chicago laboratory indicated that a run of from eight to 14 days would be necessary to get "the pure stuff in a basket on one side of the separator while the 238 was tossed into a basket on the other side." The highest run that had been accomplished was one of 20 minutes and "it didn't separate anything."

"It was then that I brought Dupont into it," General Groves said, adding that the "taint of commercialism" made the scientists reluctant to work with industrialists.

Suggested Private Meeting

"I called Dupont and told them what the whole problem was and authorized them to tell as many persons in their organization as they felt necessary to work out a solution. . . . The president of the company called me and suggested that if he and I got together alone we could arrive at a decision quickly."

Appearing at Wilmington unaccompanied, General Groves found the Dupont official had "about 25 experts lined up" for the conference. But they reached an agreement without delay.

From the Berkeley, California, laboratory where Lawrence was working on the same separation process came a report, now in government files, that "if you can develop the process, you can't design it. If you can design it, you can't operate it. If you can operate it, you won't get enough of the stuff to do you any good anyway."

Even after the fissionable material had

been secured, it took three years to design the Los Alamos bomb, the general said.

When he felt they were approaching a delivery date for a bomb, General Groves warned General Marshall, he said, that it was time to start making plans for the operation "to end the war."

"I don't want to take any more people into this than necessary," General Marshall told him, he said. So General Groves was commissioned to make the plan instead of the War Plans Division.

"On July 1, 1945," he said, "we had a bomb on Tinian, the date which I had promised long ago as a delivery date."

Bombing Message Miscarried

A "one-way code" communications system used between Tinian and his headquarters in the United States gave him some more bad moments. The message from Tinian that the bomber had taken off was routed by mistake to the Philippines while General Groves and his staff "sweated out" the deadline in Washington. The hour for dropping the bomb passed with still no word that the plane had taken off for Hiroshima.

Five hours after the bombing, he got the first report that the plane had taken off. Meanwhile he and his staff were debating whether or not to make an announcement. They had hoped to beat the Japanese in announcing the destruction of the city. Finally the announcement was toned down somewhat and put on the air—before any report on the damage had been received.

A reconnaissance flight neglected to radio back because "the smoke over the city was so thick they couldn't see anything and they didn't realize that this information was of any importance to us."

"We needed two bombs to end the war," General Groves said. "The first to tell them what it could do and the second to tell them there were more coming. It is the strongest weapon for peace ever devised. It has provided greater drive for the movement toward peace than any other single thing.

Sees Industrial Uses as Limited

"The peacetime use of atomic energy," he asserted, "is a matter of decades off. Those who talk of securing power from this source are wrong because they don't understand the difficulties of its industrial development. The industrial use of radioactivity is limited to research and as a means of telling what can happen if you can't find out any other way. It's a tool and it's not going to solve the mysteries of the world, but only assist in their solution.

"The best answer to those who say the Russians have the bomb is Dupont and the 10,000 subcontractors. The only way it can be made is the way it was made by American business in the American way. The best answer to the Russians having the bomb is that they would have to adopt the American system first before they could produce it," General Groves concluded.

A. H. d'Arcambal, Pratt & Whitney vice-president and a former ASTE president, was toastmaster for the function and introduced General Groves, Hon. Raymond E. Snyder, mayor of Waterbury, and officials of local industries.

During the evening Bernard W. Didsbury, education chairman of New Haven chapter, presented the chapter scholarship award to Alfred Westermeyer for his outstanding work in tool engineering at New Haven Junior College.

H. E. Conrad, ASTE executive secretary from the Detroit headquarters, spoke briefly on ASTE and its aims. I. F. Holland of Hartford, immediate past president, suggested having a New England meeting similar to the Connecticut Night affair.

Prior to the dinner meeting two afternoon technical sessions were held with Thomas H. Chamberlain as chairman.

S. C. Spaulding, metallurgical engineer at the American Brass Co., described types of tool steels and their uses. Slides illustrated the results of adding nickel, tungsten, chromium and molybdenum to other metals, Mr. Spaulding explaining the reasons for the results obtained.

Explains Working of Brass, Copper

The second speaker was John J. Hines, chief engineer for Waterbury Mfg. Co. His subject was "Fabrication of Parts from Brass and Copper Alloys." As Mr. Hines explained forging, casting, extruding and turning, he showed samples of each process.

In the interim between the technical sessions and the dinner, there was a social hour at the University Club rooms.

The committee in charge of the affair was headed by Mr. d'Arcambal with A. V. Pollard as vice-chairman and A. D. Proctor as secretary. Others serving on the committee were: C. S. Parsons, O. A. Gingras, M. W. Wilterdink, W. C. McDonough, G. P. Schoeller, W. F. Jarvis, R. H. Morris, M. B. Whiting, F. W. Gilbert and Walter Fisher.

City Planner Takes Oath

Charles M. Bazaz, tool designer at Wright Aeronautical Corp., Wood-Ridge, N. J., is sworn into office as a member of the City Planning Commission of Paterson, N. J., by Louis V. Hinchliffe, Passaic County court judge. Mr. Bazaz was appointed to the commission by Mayor Michael U. DeVita. Active in civic, political and church affairs, the new city planner has served on several committees in Northern New Jersey chapter and was instrumental in building membership during the chapter's early years.

Karash, Judkins Named To ASA Committees

Detroit, Mich.—Two additional ASTE representatives have been appointed to ASA committees, according to an announcement by L. B. Bellamy, national standards chairman of the Society.

J. I. Karash, process engineer, The Reliance Electric & Engineering Co., Cleveland, Ohio, has been named to Committee B5—Small Tools and Machine Tool Elements, Technical Committee No. 9, Punch Press Tools.

M. F. Judkins

J. I. Karash

M. F. Judkins, chief engineer, Firth-Sterling Steel & Carbide Corp., McKeesport, Pa., has been appointed a member of Technical Committee No. 21, Tool Life Tests for Single-Point Tools, of the B5 Committee.

Improved Methods Needed To Meet Buyers' Demands

Kansas City, Mo.—In a joint meeting with the Midwest Manufacturers Association, 140 members and guests of Kansas City chapter heard John A. Harrington, chief engineer, The DoAll Co., and vice-president, Continental Machines, Inc., speak on "Modern Methods for Improvement of Production and Quality." The meeting was held June 3 at the Advertising and Sales Executives Club.

Commenting on the present buying decline, Mr. Harrington stated that he believes people are waiting for better quality at a lower price. Although modern machines are designed to achieve this end, industry is trying to get along with old, costly methods.

When gage blocks were introduced in this country, industry as a whole rejected them, the speaker pointed out. Now they are accepted as essential to the successful duplication of parts.

Adoption of quality control has effected great savings in manufacturing plants by eliminating scrap before it becomes excessive.

In "cool" grinding a little water is dropped into a trough formed by a special flange and the grinding wheel. Centrifugal force sends the water through the voids in the wheel to the work. Temperatures at point of contact of wheel with work have been held as low as 1350 deg F and have never exceeded 1800 deg F, the speaker said.

A surface ground by this method, Mr. Harrington stated, is in much better condition than with normal grinding temperature of 2600 deg F and grain composition is not broken up.

Moncrieff Details Gear Cutting and Tools

Chicago, Ill.—A slide-illustrated lecture on gear cutting and pre-shave tools attracted some 200 Chicago members to a chapter meeting, May 10, at the Western Society of Engineers headquarters. A. D. Moncrieff, assistant chief engineer of the Michigan Tool Co., Detroit, Mich., was the speaker.

After interpreting the nomenclature used, Mr. Moncrieff explained what happens when a gear is shaved, so that the audience might understand the reason for protuberances and the specialized design problems in the three major types of pre-shave cutting tools—hobs, shaper cutters and shear speed tools.

Object of modifying the design of these tools, he continued, is to obtain a smoothly blended profile after the gear is shaved. The speaker then detailed the use of protuberances.

Turning to hob use, he emphasized that there is no use in buying precision hobs if the same consideration is not given to the use of the hob in the shop. Runout on a hob spindle, he said, has a direct bearing on work obtained from the hobbing machine.

He showed three types of eccentricity and the result on the gear, as well as the consequences of improper sharpening of the hob.

Pressure Angle Varies with Rake

If the lead is incorrectly ground there is a leaning condition in the gear tooth, while unequal gash spacing causes errors in tooth profile. A positive rake produces a small pressure angle, and negative rake gives a large pressure angle.

Mr. Moncrieff also discussed gear cutting on the Michigan shear-speed machine which operates on the gear forming principle. The tool head locates the tools, one for each tooth, in position to form the teeth and correctly spaces the gear teeth. The gear is mounted on an arbor connected to a crank that imparts reciprocation.

At the same time the tools surrounding the gear are fed with an infeed per stroke of approximately 0.005 in. decreasing gradually as the blades cut to depth.

Quoting production figures for various types of gears, the speaker stated that cutting time for most gears is one minute or less. Slides of the latest machines and design characteristics concluded the talk.

Anton Schwister, first vice-chairman, introduced the speaker.

Gives Gaging Lecture

Denver, Colo.—Louis J. Mahlmeister, manager of gage sales engineering for The Sheffield Corp., addressed nearly 60 members and guests of Denver chapter at a dinner meeting, May 4, in the Oxford Hotel.

Mr. Mahlmeister's subject, "Modern Concept of Gaging Practices," attracted visitors from Colorado Springs and Cheyenne, Wyo.

Pontiac Leads Chapters in Membership Growth

ASTE membership chairmen ambitious to build their chapter rosters will have to hump themselves to surpass records established by some of their 1948-49 predecessors.

Banner salesman for last year was Ivan D. Woodhull of Pontiac chapter. His campaign netted a 40 percent increase as of March 1.

Ivan D. Woodhull of Pontiac, champion chapter membership chairman for last year, pins Society emblem on a new member recruited during his term.

E. L. Wishart

Robert Toppin

I. W. Barker

J. M. Speck

Approaching prospects in a businesslike manner, Mr. Woodhull and his team showed them data sheets and *The Tool Engineer*, told them about benefits of chapter meetings, technical programs, professional contacts, outings and social events.

When they met indifference or excuses, in checking back on unreturned application blanks, they figured out a new angle. The membership workers filled in the forms themselves, securing the applicant's signature and dues. This painless method was much more effective.

Unconsciously Membership Chairman Woodhull was goaded on by the tactics of a rival team, headed by Eldon R. Hall, chapter chairman. Every few days Mr. Hall would ask Mr. Woodhull for more application forms, until he had received about 60 blanks. Between the efforts of the two teams, this spirited drive boosted the nose count from 72 to 101.

Next highest gain was at Cedar Rapids where John M. Speck chalked up a 31 percent increase. At the end of the year membership stood at 133 against 101 at the beginning of his term.

Through the efforts of G. R. Jarman, Fox River Valley experienced a growth of 20 percent, from 103 to 125.

Portland, Maine, a plucky little group that has been beset with recurring misfortune, advanced its numbers 16 percent—from 42 to 49—under the direction of Eldon L. Wishart. The sole ASTE group in the Pine Tree State, this chapter has members who travel more than 200 miles to attend meetings.

Gains Widespread

Houston chapter demonstrated its city's go-getting ability by a 13 percent addition to the rolls. I. W. Barker was in charge of the activity that brought a 258 membership count up to 292.

At Fort Wayne E. G. Chambers registered an 11 percent increase. When he took office, his chapter had 225 members. Since then an even 25 men in that area have joined ASTE.

Hartford won 56 recruits, the largest number credited to a single chapter. Membership soared 10 percent, from 538 to 594. Robert Toppin was the energetic membership chairman behind this movement.

Other chapters showing membership gains during the past year are: Racine, Cleveland, Milwaukee, Pittsburgh, Toledo, St. Louis, Central Pennsylvania, Toronto, Peoria, Boston, Indianapolis, Williamsport, Montreal, Louisville, Atlanta, Denver, and the At Large group.

Micro-Hardness Tester Checks Watches, Tools

Fort Wayne, Ind.—"Current Trends in Hardness Testing" was the closing technical subject of the Fort Wayne chapter season. This topic was presented by V. E. Lysaght of the Wilson Mechanical Instrument Co., Bridgeport, Conn., at a dinner meeting, May 11.

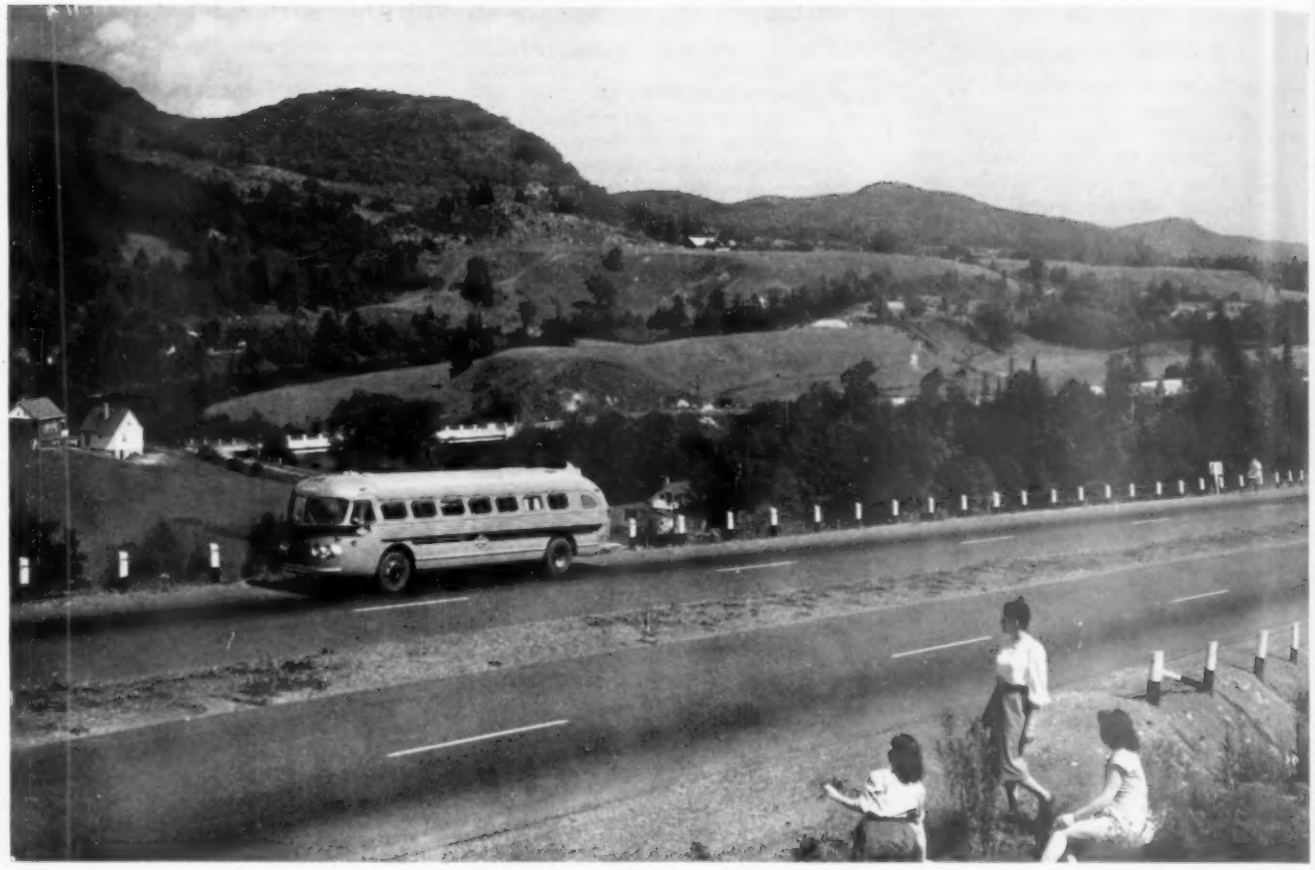
Mr. Lysaght, who has specialized in hardness testing of metals, discussed in detail all types of testers now on the market.

The relatively new Knoop indenter system was well illustrated with slides. Tiny parts can be checked with this micro-hardness tester, he said.

The watchmaking industry here and abroad, Mr. Lysaght indicated, is extremely interested in the application and accomplishments of this equipment. The cutting tool field also finds the new process interesting, since it gives a more positive hardness reading in the study of chip removal.

Coffee speaker was F. R. Clouse of the Auburn Stoker Co. A collector of old automobiles, Mr. Clouse enlightened the chapter on the early history of motor cars. His collection includes a 1900 Toledo steam carriage, a 1911 Hupmobile and a 1920 Milburn electric car, he told the group.

Approximately 100 men attended the meeting.



Editorial Associates, Ltd. Photo

Your LAURENTIAN *Holiday*

Montreal Convention Goers to See Fall Beauty of Canadian Mountain Playground

Do YOU long to get away from the throb of machinery, the noise and confusion of the city, and all the futile rush of modern living?

That's what your fellow tool engineers at Montreal thought. So they've arranged a refreshing holiday for you in a quiet mountain fastness away from the distractions of busy industrial centers. October 29, final day of the ASTE 17th semi-annual meeting in Canada, is reserved for a motor tour through the Lordly Laurentians, a giant backbone extending from the Straits of Belle Isle across the Province of Quebec.

Through the abrasive action of long-receded glaciers, these peaks have been gently rounded and dimpled with thousands of lakes fed by tumbling streams. Their Pre-Cambrian formation contains the oldest type of rocks exposed on the earth's surface.

Reflects Old French Heritage

Early settlers of this region were farmers from Normandy and Brittany attracted by the rich natural resources of furs and timber. In log or stone farmhouses revealing French characteristics, their descendants still maintain the little communities founded by these pioneers.

Here life is uncomplicated—it revolves about the family, the kitchen and the soil. Those who do not cultivate the land, cut lumber, carve wooden novelties, make habitant furniture and weavings.

A fine highway system now brings this idyllic land to Montreal's back door.

Comfortable sightseeing buses will carry the ASTE party along a broad road through the picturesque hamlet of Sainte-Rose on la Riviere des Milles Iles, skirting Sainte-Therese. An old mill built here in 1816 still grinds grain and saws lumber, although the water which originally powered it is now converted to electricity.

Beyond is Saint-Jerome. This manufacturing town on the turbulent Riviere du Nord is the largest community north of Montreal and the gateway to the Laurentians. Its annual Passion plays are said to compare favorably with the Oberammergau performances.

Set amid sparkling lakes are Shawbridge and Piedmont, the first resort villages in this area of luxurious tourist hotels.

Then comes Mont-Rolland with its paper mills and hydro plant. About one and one-half miles farther on Sainte-Adele perches on a hillside overlooking colored roofs of chalets nestled in the valley.

Mountain Inns to Serve Luncheon

Here the convention visitors will separate into three groups and proceed to the resort hostelries selected for luncheon. Nearest is the dormered Sainte-Adele Lodge, set in its cluster of French-Canadian type cottages.

Above Round Lake and the village of Sainte-Adele is the rambling and cozy Chantecler Inn. A pre-luncheon rest in the piney air of the flagged sun terrace will sharpen the most jaded appetite.

Turning right from Sainte-Adele, the road leads to the Alpine Inn at Sainte-Marguerite Station on the North River. Ruggedly constructed of logs, the Alpine has spacious lounges and great stone fireplaces that crackle hospitably with cheery fires.

Tops Off Busy Weekend Program

After a superb meal and a stroll around estate-like grounds, the three groups will meet at Sainte-Adele for the return trip to Montreal and the banquet—climax of a day and a convention filled with memorable events.

As outlined in the June issue, two days of outstanding technical sessions, plant tours and other activities will precede the Laurentian tour. Details will follow in subsequent issues, but don't wait for the formal invitation. Headquarters will enter your advance reservation now. Send your request to Howard Windsor in care of the Society at 10700 Puritan Avenue, Detroit 21, Mich. It's your guarantee of another good time and profitable get-together with tool engineers from above, below and beyond the border.

Members who attend Montreal convention will have difficulty choosing from among attractive hotels selected for luncheon on a trip through the Laurentian Mountains. Top: Sainte-Adele Lodge, in the hillside village of the same name, spreads its main buildings and French-Canadian cottages around a swimming pool and tennis courts. (Photo by E. Comellas.) Center: The flagged sun terrace of Chantecler Inn overlooks beach and mountains. (Photo by Frank Scofield) Bottom: The sturdy log construction and stone fireplaces of the Alpine Inn at Sainte-Marguerite Station give an atmosphere of informal hospitality. (Canadian Pacific photo.) All have distinguished cuisine.

Flint Members See New Kettering Engine at Olds Plan

Flint, Mich.—The Oldsmobile division of General Motors Corp. at Lansing was host to Saginaw Valley chapter, May 19.

After dinner in the engineering building, Chairman Harold DeVore presented Donald Burnham, manufacturing manager of Olds. Mr. Burnham welcomed the group and spoke briefly on tooling and plans for expanding the Kettering engine plant.

Motion pictures showed the visitors the research leading to the new engine and its testing at the General Motors proving grounds. In climbing steep grades, acceleration, economy and vibration, the high compression motor excelled the Olds straight eight model.

Following the film showing the engineers were conducted in small groups through the engineering department where a complete scale model of the engine plant was displayed. As they proceeded through the plant they saw process machines 87 feet long. An efficient layout places machine operations directly opposite points where the respective parts are assembled to the engine.

Automatic chip disposal conveyors are built under the floor of all automatic process machines. The engine assembly line is a flush floor type with mushroom stands so operators can walk around the engines.

Moving on to the block test stands, the Flint area ASTE'ers saw the engines tested and painted. Here dynamometers check the fluid coupling, a unit separate from the automatic transmission, which is assembled to the engine.

Attended by 282 members and guests, the tour was the last meeting of the chapter until September.

Conrad Presents Gavel

Re-enacting ceremony of three years ago when he chartered Evansville chapter, Executive Secretary H. E. Conrad, presents gavel to Chairman W. P. Schneider as the latter takes office.

Diamond Heads NAEC

Detroit, Mich.—B. L. Diamond, president, Diamond Engineering Co., Detroit, was elected president of the National Association of Engineering Companies at the annual membership and board meeting here recently.

Other officers elected are: Vice-president, Walter W. Schmitt, president, Product Engineering Service, Inc.; secretary, Wiley F. Chapman, general manager, Detroit Service Engineering Co.; and treasurer, Harry L. Murray, owner, Murray Engineering Co.

Mr. Chapman was elected to the board, with Mr. Schmitt and Mr. Murray being named for another term as directors. All of the new officers are members of Detroit chapter, ASTE.

New Officers at Muncie

Muncie 1949-50 officers conducted their first meeting when R. D. Meyers of Indiana Oxygen Co. presented a laboratory demonstration of liquid oxygen and its uses. From left: Charles L. Marker, chairman; Robert L. Weimer, second vice-chairman; Arthur F. Kurtz, first vice-chairman; Melville R. Troyer, secretary; and N. Francis Wilson, treasurer.

Shows Motions in Method As Vital to Tool Design

Utica, N. Y.—"The Next Ten Years for the Tool Engineer" was the subject of a talk by J. L. Schwab, New England divisional manager, Methods Engineering Council, at a dinner meeting of Mohawk Valley chapter, May 24.

Approximately 75 members and guests attended the dinner and technical session at New York State Institute.

Outlining a tool engineer's qualifications, Mr. Schwab emphasized that quality in tool design is not enough. Tool engineers can effect economies by considering all other requirements, including tool cost and application.

Machine operators, the speaker pointed out, become fixed in their ways of using tools, if the proper method is not predetermined by the engineer.

Mr. Schwab elaborated on such basic motions as movement, grasp, transfer, positioning, disengaging and applying pressure, required in machine operations. An important factor in operational cost, motions in method must be studied when developing tools, he said.

A short question period followed the lecture. E. J. Masucci, chapter chairman, presided at the meeting.

Two Institutes Added To ASTE-Approved List

Two more technical institutes have qualified for ASTE approval of their tool engineering curricula, the National Education Committee has announced. They are the Allied School of Mechanical Trades in Chicago and the Ryerson Institute of Technology at Toronto.

The Chicago institution is the first in that area to receive Society approval of its courses. Through the efforts of Thomas C. Barber, first vice-chairman of Chicago chapter, a student chapter of approximately 40 members is being formed there. Mr. Barber is organizing the Education Committee to continue this work and to establish other student sections.

At the Ryerson school, Toronto chapter has been conducting a tool design course as part of the School of Machine Tool Technology sponsored by the Province of Ontario. Roy M. Sherk of the chapter Education Committee heads the Machine and Shop Work Division of the School of Technology.

Institutes previously approved include: Williamsport Technical Institute, Connecticut Engineering Institute, Ford of Canada Trade School, Rhode Island State College and Rochester Institute of Technology.

Situations Wanted

ENGINEERING EXECUTIVE—46, seeks position as chief engineer or in other responsible post. Experienced automotive production, manufacturing of hydraulic machines, precision lamination dies, welding machines and spot weld guns. Graduate aeronautical engineer. Please address replies to Box 170, American Society of Tool Engineers 10700 Puritan Ave., Detroit 21, Mich.

MACHINERY SALES EXECUTIVE—available for connection as sales manager or representative. Familiar with Middle West and East Coast territory; willing to travel anywhere. Would like assignment in Mexico. Qualifications include honesty, tact and conscientiousness. For further information write to Box 171, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

METHODS ENGINEER—27, experienced making new machine proposals with cost breakdown and time saving effected; establishing speeds and feeds for maximum product quality and machine life; figuring gearing. Nine years' shop experience includes two years with Army Ordnance. Prefer location in New England or New York, but available outside this area. Married, free to travel; have commercial pilot's license. Brown & Sharpe apprentice graduate; completed course at R. I. School of Design. Please address inquiries to Box 172, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

Douglas Announces National Committee Appointments for 1949-50

Acceptances of 57 ASTE members to appointments on nine national committees have been announced by R. B. Douglas of Montreal, Society president.

From the ranks of capable and experienced men available, Mr. Douglas has made assignments to committee chairmanships. Chairmen in turn have selected their coworkers with careful consideration of widespread chapter representation.

Several chairmen have been reappointed to continue long range programs; others have been advanced in line with the rotation procedure established for their particular groups.

Law-Making Group Continues

The Constitution and By-Laws Committee remains intact as follows: Chairman, R. R. Linch, (Los Angeles chapter), partner-manager, National Distribution System, Hollywood, Calif.; E. J. Berry (Little Rhody), partner, Berry Engineering Service, Providence, R. I.; and E. H. Ruder (St. Louis), plant engineer, Sunnen Products Co., St. Louis, Mo.

J. N. Edmondson (Columbus), professor of industrial engineering at Ohio State University, Columbus, Ohio, has advanced to the chairmanship of the National Education Committee, succeeding Prof. H. F. Owen of Purdue University, recently elected third vice-president of the Society.

Continuing with Professor Edmondson are: S. B. Hagberg (Rochester), instructor, mechanical department, Rochester Institute of Technology, Rochester, N.Y.; P. A. Smith (Boston), assistant professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.; and C. D. Wright (Niagara District), chief engineer, Reliable Toy Co., Ltd., Toronto, Ont.

A. R. Diamond (Philadelphia), mechanical engineer, Jackson-Walter Co., Philadelphia, Pa., is the only new member of the committee.

McMillen Heads Finance

H. C. McMillen (Evansville), general superintendent, Seeger Refrigerator Co., Evansville, Ind., and W. F. Jarvis (Hartford), plant superintendent, Charles L. Jarvis Co., Middletown, Conn., are both new to the National Finance Committee.

Mr. McMillen, the chairman, has retained from the previous committee: National Treasurer G. A. Goodwin (Dayton), chief process engineer, Master Electric Co., Dayton, Ohio; H. R. Nelson (Chicago), vice-president and general manager, Charles L. Anderson Machinery Co., Chicago, Ill.; and J. L. Webster (Northern New Jersey), master mechanic, Eclipse Pioneer Div., Bendix Aviation Corp., Teterboro, N.J.

The Handbook Committee begins its sixth year with its original members and subsequent additions. They are: Chairman, E. W. Ernst (Schenectady), superintendent, Punching, Tool and Die Div., General Electric Co., Schenectady, N.Y.; vice-chairman, F. W. Curtis, consulting engineer, Springfield, Mass., and A. L. Potter, assistant general manager, Eastern States Exposition, Springfield, Mass., both of Springfield chapter.

President R. B. Douglas (Montreal), president, Godscroft Industries, Ltd., Montreal, Que.; Harry Crump (Detroit), chief tool sales engineer, Carboloy Co., Inc., Detroit, Mich.; B. C. Brosheer, associate editor, *American Machinist*, Chicago, Ill., and Frank Martindell, development engineer, Teletype Corp., Chicago, Ill., both of Chicago chapter.

National Committee Chairmen

L. B. Bellamy

H. C. McMillen

J. N. Edmondson

J. A. Siegel

F. J. Schmitt

W. A. Dawson

R. R. Linch

H. B. Osborn, Jr.

E. W. Ernst

Siegel, Dean of Past Presidents

Automatically composed of the nine past presidents oldest in term of office, the Judicial Committee consists of: J. A. Siegel, chairman, sales engineer, Haberkorn Machinery Co., Detroit, Mich., T. B. Carpenter, owner, Bert Carpenter Machinery Co., Birmingham, Mich., F. A. Shuler, retired, Detroit; W. H. Smila, master mechanic, Plymouth Div., Chrysler Corp., Detroit, and W. F. Wagner, master mechanic, Lincoln Motor Co., Detroit, all of Detroit chapter.

F. W. Curtis, consulting engineer, Springfield, Mass., and J. R. Weaver, vice-president, Baldwin Locomotive Works, Philadelphia, Pa., both of Springfield, Mass., chapter; R. M. Lippard (Worcester), assistant sales manager, Heald Machine Co., Worcester, Mass.; and A. H. d'Arcambal (Hartford), vice-president-consulting metallurgist, Pratt & Whitney, West Hartford, Conn.

Entirely new is the staff of the National Membership Committee. Headed by Dr. H. B. Osborn, Jr., (Cleveland), technical director, Ohio Crankshaft Co., Cleveland, Ohio, it includes: C. L. Bendle (Detroit), owner, C. L. Bendle Co., Ann Arbor, Mich.; B. J. Hazewinkel (Denver), district representative, L. S. Starrett Co., Denver, Colo.; C. M. Smillie (Detroit), owner C. M. Smillie Co., Ferndale, Mich.; and H. H. Whitehall (Hamilton), president and general manager, Harry H. Whitehall Co., Hespeler, Ont.

Dawson Reappointed

Reappointed to the Committee on Professional Engineering are: W. A. Dawson, chairman (Hamilton), branch manager, F. F. Barber Machinery Co., Hamilton, Ont.; E. J. Seifreat (Dayton), president, Seifreat Elstad Machinery Co., Dayton, Ohio; L. G. Singer (Toronto), district manager, Williams & Wilson, Ltd., Toronto, Ont.; P. R. Weitzman (Fort Wayne), factory manager, Sheller Mfg. Corp., Portland, Ind.; and G. S. Wilcox, Jr. (Detroit), assistant factory manager, Plymouth Div., Chrysler Corp., Detroit, Mich.

Robinson and Stronks Named

R. I. Robbins (Boston), chief project engineer, Anderson-Nichols & Co., Boston, Mass., and R. G. Stronks (Los Angeles), chief draftsman, Snyder Engineering Corp., Los Angeles, Calif., are new members of this group.

Officers of the National Program Committee have been promoted as follows: F. J. Schmitt (Chicago), director of sales, D. A. Stuart Oil Co., Chicago, Ill., succeeds E. W. Baumgardner of Cleveland, Ohio, as chairman. G. A. Rogers (Montreal), sales engineer, Rudel Machinery Co., Ltd., Montreal, Que., becomes first vice-chairman. Gardner Young (Pittsburgh), tool supervisor, Westinghouse Electric Corp., Pittsburgh, Pa., is second vice-chairman.

Left: A. B. Willi, vice-president of Continental Motors Corp., tells Detroit chapter how his company developed air cooled engine for combat vehicles. Above: M. O. Cox, chapter chairman, visits with a group of members and guests attending meeting. From left: C. Ray Brunner, former national secretary; A. E. Rylander, technical editor of The Tool Engineer; Mr. Cox, Eric Garbrom of Sweden and Harold Carlson of New York City, both guests of Mr. Brunner.

J. O. Horne (Rochester), sales manager, James O. Horne & Co., Rochester, N. Y., is now secretary, and C. N. Flick (Cincinnati), assistant chief tool engineer, Cincinnati Milling Machine Co., Cincinnati, Ohio, will serve another term on the committee.

Now appointees are: A. B. Clark (Cleveland), office manager, Haynes-Stellite Co., Cleveland, Ohio; H. M. Creasey (St. Louis), assistant plant manager, General Metal Products Co., St. Louis, Mo.; H. S. Hunt (Greater New York), plant superintendent, Sipp-Eastwood Corp., Paterson, N.J., and E. J. Raves (Golden Gate), plant superintendent, Grove Regulator Co., Oakland, Calif.

The 1948-49 National Standards Committee continues in office. The chairman, L. B. Bellamy (Detroit), district manager, Sterling Grinding Wheel Co., Detroit, Mich., will be assisted by: Vice-chairman, E. J. Marasko, engineering department, Brush Development Co., Cleveland, Ohio; and E. O. Harvey, Ohio district manager, Modern Corp., Detroit, Mich., both of Cleveland chapter.

William Moreland (Rockford), production manager, Greenlee Bros & Co., Rockford, Ill.; R. C. Peterson (Toledo), manager, Peterson Engineering Co., Toledo, Ohio; W. A. Thomas (Windsor), supervisor, tool engineering, Ford Motor Co. of Canada, Windsor, Ont., and G. S. Wilcox, Jr. (Detroit), assistant factory manager, Plymouth Div., Chrysler Corp., Detroit, Mich.

The addition of A. M. Swigert (Detroit) vice-president, Universal Products Co., Dearborn, Mich., completes this committee.

Organization of these departments of ASTE activity is now underway. In accordance with the trend toward economy in Society operation, traveling will be limited to key members of each group. Appointments to several other committees will be announced when completed.

Former S.A. Navy Man Is Good Will Speaker

Milwaukee, Wis.—"Let's Think as Americans" was the theme of a talk given before Milwaukee chapter at a meeting in the Elks Club, May 12. Carlos Fallon, former chief of staff of the Colombian Navy, was the speaker. His humor and knowledge of current events made this subject highly interesting.

A native of Bogota, Colombia, where he received his early schooling, Mr. Fallon speaks with a slight Scandinavian accent acquired, he says, as an apprentice seaman in the Danish Navy.

After resigning his post in the Colombian Navy, he joined the U. S. Air Force as a private in World War II and became a citizen of this country.

His present occupation seems to be that of unofficial Latin-American ambassador of good will.

Professor Halsey F. Owen of Purdue University, third vice-president of the Society, was a surprise guest. He spoke briefly on the qualifications of a tool engineer and stressed advantages of ASTE membership. His visit was a homecoming as he is a University of Wisconsin alumnus and worked in several Milwaukee shops. Chairman Arthur Gudert presided.

Lewis Tells How to Save On Clamping Equipment

Seattle, Wash.—"Welding and Fixture Clamping" was explained to 45 members and guests attending a meeting of Seattle chapter, May 10. Arthur D. Lewis of the Art Lewis' Production Equipment Co., Los Angeles, Calif., was the speaker.

The demand today, said Mr. Lewis, is for low cost holding and clamping equipment, incorporating production features. Inexpensive clamping units, readily available, will meet this need, he pointed out. A welding film, illustrating such fixtures, augmented his talk.

A director-elect of ASTE, Mr. Lewis also reported on the Pittsburgh convention and displayed a dummy of the "Tool Engineers Handbook."

Willi Discusses Tooling Of New Army Engine

Detroit, Mich.—Production aspects of heavy duty, air cooled engines for combat vehicles, recently developed for the U. S. Army, were the subject of an address by A. B. Willi, vice-president of Continental Motors Corp., during a dinner meeting of Detroit chapter, May 12, at the Engineering Society of Detroit. Mr. Willi spoke in place of C. J. Reese, company president, who was unable to be present.

In carrying out this army assignment, Mr. Willi explained, Continental drew on its long experience in building air cooled aircraft engines and in converting them to tank service during the war. This experience helped in developing an engine light and compact, though high in horsepower output.

Replacement Parts Reduced

Problems and restrictions in building a series of such engines, ranging from 100-1000 hp, were described by the speaker. As built by Continental, the engines are classified into two cylinder sizes. Power desired is then determined by varying the number of cylinders. The basic method of design cuts replacement parts to a minimum, an important consideration with the armed forces.

Continuing, Mr. Willi detailed machines necessary to produce these engines. The modest quantities required and the relatively short amortization period for special machines were strong guiding factors in setting up the plant for this program, he added.

L. B. Bellamy, national standards chairman, director-elect and a chapter member, was the coffee speaker. He announced plans for issuing new data sheets and commented on the increasing popularity of the present indexing system. Complete data sheet books, he stated, are being presented to some 50 Detroit firms in order to acquaint them with the Society's efforts in aiding industry.

New York Students Form T.E. Society

Canton, N. Y.—The Student Tool Engineers Society has been organized at the New York State Agricultural and Technical Institute by students enrolled in metal products manufacturing, technical drafting and machine design courses. Richard Eno, faculty advisor and a member of Rochester chapter, ASTE, headed the organizational activity.

Aim of the group is "to unite students in the tool engineering field, to exchange ideas, to provide satisfactory means of carrying on relations with other groups and persons in the tool engineering field." They have submitted some 30 applications for membership in ASTE.

Officers are: Fred Branham, president; Harold Lloyd, secretary-treasurer; and Lawrence Newton, corresponding secretary.

Meetings are held the first Thursday of each month at 7:30 p.m., in the main building of the institute. Out-of-town members of ASTE are welcome.

Award Opened Many Doors, Says Scholarship Winner

Cleveland, Ohio—Benefits of the Cleveland chapter $500 scholarship are manifold in the experience of the 1948 winner, Thomas Rogers, who graduated last month from Case Institute of Technology, told the scholarship donors how their award had helped him in his senior year, at a joint meeting of the Cleveland ASTE and SAE groups, May 9.

The award came at the psychological moment "since my G. I. Bill, under which I was attending Case, ended last June with my junior year. But your scholarship was there to take over and pay the greater part of my senior year tuition."

Another feature which Mr. Rogers appreciated was that he did not have to be the top man in his class to be eligible. The award recognition spurred him on and since then, he says, he has been elected to Tau Beta Pi.

Although he had selected the heat-power option in mechanical engineering, he changed to the machine design option after receiving the scholarship and visiting the 1948 ASTE tool show at Cleveland. He found the transfer highly satisfactory and credits it with the fine offer of employment which he has accepted since graduation.

Interviewers visiting Case seemed especially interested in the award. With the employment situation beginning to tighten up, Mr. Rogers was grateful that he had this additional inducement to offer prospective employers.

The junior membership in ASTE which accompanied his award enabled him to attend chapter meetings and learn some of industry's problems, the approach and final solution. "This change from the theory of the schoolroom is invaluable to the student engineer. At the meetings I had opportunity to associate with the kind of men I hope to be working with in the near future.

"Along with the membership," Mr. Rogers added, "I receive *The Tool Engineer* magazine. This technical publication is very interesting to me as it shows new industrial developments which, of course, are impossible to keep up with in a schoolroom."

Winning the scholarship was also instrumental in placing Mr. Rogers in a training program last summer. A society like ASTE, he believes, could make a worthy project of interesting industrialists in hiring student engineers during vacation periods. This would make the graduating engineer a much more valuable man to industry, he concluded.

The Cleveland chapter annual scholarship is open to any Greater Cleveland junior engineering student enrolled at a recognized school in the United States. It is financed by special chapter events.

L. A. Has Stag Dinner

Los Angeles, Calif.—Fox Hills Country Club near Inglewood was the scene of a stag dinner party for Los Angeles chapter, May 13.

Some 300 members and guests were served a buffet dinner and were entertained with 10 acts of vaudeville.

Harold Lewis, chairman for the affair, and A. J. Lewis handled arrangements.

Top: J. H. Schron, immediate past chairman of Cleveland chapter, awards chapter's 1949 $500 scholarship to Alfred C. Montag, junior engineering student at Case Institute of Technology. Lower: The selection committee considers applications from schools all over the country for the annual award. From left: Dr. William Pindell, dean of men at Baldwin-Wallace College; E. W. Dase, education chairman; S. B. Taylor, president, Parker Appliance Co.; J. H. Schron, chairman when award was initiated; and Walter K. Bailey, vice-president at Warner & Swasey Co.

Cleveland Scholarship Awarded to Case Student

Cleveland, Ohio—In the presence of some 300 members of ASTE and SAE, Cleveland chapter awarded its 1949 $500 scholarship to Alfred C. Montag, junior engineering student at Case Institute of Technology. SAE was host to the ASTE chapter at a meeting held May 8 at the Tudor Arms Hotel.

J. H. Schron, immediate past chairman in whose term this award was initiated, made the presentation. In addition to the $500 scholarship, Mr. Montag also received a paid-up junior membership in ASTE and a permanent record of his achievement, engraved on a beautifully bound scroll and signed by Cleveland chapter officers.

E. W. Dase, education chairman, directed the scholarship project. The selection committee was chairmanned by Walter K. Bailey, vice-president of Warner & Swasey Co. Serving with him was S. B. Taylor, president of the Parker Appliance Co., and Dr. William Pindell, dean of men at Baldwin-Wallace College, Berea, Ohio.

Committee Worked Anonymously

Remaining anonymous until the award announcement, the committee chose Mr. Montag over applicants in engineering colleges and universities throughout the country.

Thomas Rogers, winner of the 1948 scholarship, was present and briefly outlined ways in which his award has helped him.

Principal speaker of the evening was Dr. M. E. Merchant, senior research physicist of the Cincinnati Milling Machine Co. Highlight of his address, "Chip Formation, Friction and Finish in Machining Operations," was a film in microphotography, "Physics of Metal Cutting."

In slow motion and under the microscope, these pictures showed single-point tools cutting various materials, both dry and with coolant. They clearly depicted how the correct shear angle of the chip is dependent on proper rake angle of the tool. The film also demonstrated how the shear angle changes under dry cutting conditions and reverts when coolant is applied.

At the conclusion of Mr. Merchant's talk, the audience engaged him in a lengthy question and answer period.

GET ONE *Tool Engineers Handbook**

*2000 pages of basic tool engineering information. Price to members only, $11.

Boston Group Visits Auto Assembly Plant

Boston, Mass.—Boston chapter made its annual plant visitation, May 12, to the new General Motors assembly plant in Framingham.

About 300 members and guests toured the factory during the afternoon and watched Buick, Oldsmobile and Pontiac cars being assembled on huge conveyor lines.

Component parts, such as metal stampings for fenders and floors, motors and frames, received from Flint, Lansing, Grand Rapids and other plants, were lined up along the line for assembly to cars on the moving conveyor.

Tool engineers and guests were permitted to walk around freely and inspect assembly fixtures and tools, such as portable spot welders and power wrenches. All spray booths are equipped with an elaborate water-and-air down-draft ventilating system which removes paint fumes so efficiently that workers need no respiratory devices.

"Body Drop" Precision Timed

At the "body drop" a chassis and body, each built in different sections of the plant, arrive simultaneously at the final line, by means of an intricate timing schedule.

The tour concluded when the group reached the end of the line where the cars are driven off—all tested, checked, and ready for delivery.

After the plant visit the party assembled at Nevins Memorial Hall for dinner. Chairman Joseph P. Crosby introduced several guests, including E. K. Cunliffe, personnel director of the General Motors plant, and W. Randall, chairman of the Framingham Board of Selectmen. ASTE chapter chairmen also were present from Worcester, Hartford, Little Rhody, Springfield, Mass., and Twin States chapters.

A. J. Leone, first vice-chairman, introduced Alexander Strong of Rath & Strong, a Boston firm of industrial engineering consultants.

Speaking on "Effective Utilization of Time in the Manufacturing Process," Mr. Strong explained how time could be saved through changes in physical layout, work simplification, methods, better machines, tooling and setups.

Causes of delays such as tool and machine breakdowns, waiting for tools and instructions also were discussed. The speaker dealt at length on the value of properly installed incentive systems.

Mr. Strong concluded his talk by answering questions from the floor.

GET ONE *ASTE Building Fund Participation Certificate**

*The 4½% interest on a $300 certificate will pay your annual ASTE dues, purchase a "Tool Engineers Handbook" and leave money for other things.

Prominent in tour of Framingham, Mass. General Motors plant, sponsored by Boston chapter, were, from left: Alexander Strong, principal speaker; E. K. Cunliffe, director of personnel at the Framingham plant; William Randall, chairman of Framingham Board of Selectmen; A. J. Leone, first vice-chairman; and Joseph P. Crosby, chairman, of Boston chapter.

Oxford Reports New Developments in Perishable Tools

Carl J. Oxford, chief engineer of National Twist Drill & Tool Co., Rochester, Mich., answers questions concerning drills, reamers and milling cutters following lecture at Cedar Rapids chapter on advances in perishable tools. From left: W. H. Johnson, J. M. Speck, education chairman; Mr. Oxford and Robert J. Walters, representative of Winter Bros. Tap Division.

Adapts Grinding Methods To Southern Requirements

Atlanta, Ga.—Atlanta chapter closed its season with a dinner meeting May 16 at the faculty dining hall of Georgia Tech.

Zack Almand, local engineer for Carborundum Co., lectured on "Proper Selection of Grinding Wheels and Machines to Suit Southern Needs."

In discussing problems encountered, he explained how to choose grinding wheels for specific metals, described the use of carbide cutting tools and commented on the use of grinding wheels in cutting marble and granite, two of Georgia's major products. Mr. Almand concluded his talk by showing films on grinding techniques.

James Cogburn, delegate to the Pittsburgh convention, reported on the national meeting.

Committee chairmen appointed by Charles M. Jenkins, chapter chairman, are: Charles F. Bolden, Jr., program; Charles B. Harbin, standards; James M. Eidson, constitution and by-laws; James C. Cogburn, membership; Frank F. Ford, public relations; Matthew W. Kemp, editorial; and William R. Smith, education.

The Public Relations Committee plans to issue a chapter bulletin.

Editor Shows Ingenious Screw Machine Tooling

St. Louis, Mo.—Arthur Ainsworth, editor of *Screw Machine Engineering*, was technical speaker at the May 5 meeting of St. Louis chapter, attended by approximately 138 members and guests.

Mr. Ainsworth gave an interesting and instructive talk on tooling, cam design, setup and operation of Brown & Sharpe and multi-spindle automatic screw machines.

Slides illustrated these phases as well as parts layout. Many of these slides emphasized the enormous time saving possible by ingenuity of setup and proper tooling, resulting in increased production, better finishes, longer tool life and closer tolerances.

Rockford Sees Farm Tractors Roll Off Assembly Line

Rockford, Ill.—More than 50 members of Rockford chapter participated in a recent field trip to the postwar light farm tractor plant of John Deere & Co. at Dubuque, Iowa.

Sigurd G. Lunde, a mechanical engineer at the plant and a former chairman of Tri-Cities chapter, was in charge of the tour. Guides escorted the party in small groups through the general office, the engineering and experimental departments and the chemical and metallurgical laboratories.

After pausing for lunch at the plant cafeteria, the visitors proceeded to the heat treating and plating departments. Since the plant is beyond the city limits, propane gas is used to fire the furnaces for carbo-nitriding the 8460 gears. Tocco units are employed to harden the cam shafts.

See Home Town Machines

At the automatic screw machine department, Rockford-made machines and equipment were seen in action. Many ASTE'ers lingered in the gear finishing section to watch high speed machines simultaneously cutting all the teeth on a shouldered transmission gear.

Another interesting stop was made at the noise testing unit which checks tractor transmissions after assembly.

Before installation in the tractor, the completely assembled engine is checked on a test stand. The vertical, two-cylinder engine is given a 45-minute run-in, then checked on a dynamometer for full horsepower rating.

Among other highlights was the crankshaft balancing machine with stroboscopic lighting to assist the operator in making hole locations. Another point of interest was in the press department where a number of die sets were being used simultaneously in a press for deep drawing operations on gas tanks.

After viewing the main tractor assembly line, the Rockford engineers saw the finished product being painted and driven off the floor under its own power.

Foundry Conveyorized

A final stop was made at the foundry. Here conveyors are used extensively to facilitate the handling of large castings. Sands are delivered to the mold from overhead chutes. After the cores are placed in the mold, it moves along the conveyor line and molten metal is poured into it from overhead cranes. The mold continues along the line to cool before being dumped. The casting is then cleaned, chipped and the sand removed.

After completing the tour the group returned to Rockford in their chartered buses, stopping at East Dubuque for dinner.

* * *

The last meeting of the season was held May 5 at Hotel Faust, when W. A. Williams, chief engineer for the American Pulley Co., Philadelphia, Pa., discussed the "History of Power Transmission."

Mr. Williams' study of this subject has revealed that wooden gears were common in ancient Egypt and Rome. One application was in grinding grain with a water wheel.

The mileage indicator, he said, is some 2000 years old. By means of a peg on a wheel spoke, chariots translated wheel revolution, through a gear train, into distance traveled.

Much of Mr. Williams' talk was illustrated with slides made from cuts and sketches in old books in technical libraries and museums throughout the United States.

Steam Engine First Used in Mines

Main reason for inventing the steam engine, Mr. Williams went on, was the need for a machine to remove water from coal mines in England. James Watt made his own boring machine to produce the cylinders—75 in. in diameter, with a stroke of 96 in. Tolerances then were plus or minus 3/8 in.

Among other stories of early power transmission devices, he related how a master clock was employed in Paris in 1835 to run a great number of clocks by sending out a 20-second pulse of air which moved the synchronized timepieces a one-minute increment.

Most of these old ideas, the speaker concluded, are still used in a more advanced stage of design or application.

As an added attraction color motion pictures were shown of the launching preparations, takeoff and flight of the V-2 rocket.

Lectures on Castings

Windsor, Ont.—For the final meeting of the Windsor chapter season, E. Long Co. of Orillia presented C. E. Herington of Meehanite Metal Corp. in a lecture, "Quality Castings—the Key to Greater Production."

Well informed on his subject, Mr. Herington stated his facts in a manner that put them across to the audience without repetition. Slides and a sound film accompanying his talk emphasized the merits of the subject metal, Meehanite.

Top: Rockford tool engineers set out on a field trip to the John Deere farm tractor plant at Dubuque, Iowa, and (center) look over completed tractors during plant tour. Bottom: George Torrence and Elliott Carlson (left) ask questions of W. A. Williams of the American Pulley Co., who discussed "History of Air Transmission" at recent chapter meeting, as Chairman Karl Kaiser (right) looks on.

Modern Methods of Competitor Can Peril Profits—Ball

Montreal, Que.—Nothing threatens a company's profit more than enlightened methods in the hands of a competitor, Q. R. Ball, assistant superintendent of Northern Electric Co., informed 104 engineers attending the May 12 meeting of Montreal chapter.

In motion pictures Mr. Ball showed how work simplification can step up production as much as 200 percent while making the job easier for the operator.

This is done by designing inexpensive fixtures, using foot controls, gravity feeds, drop disposal chutes, prepositioning tools and by eliminating "therbligs."

"Therbligs" were interpreted as engineering double-talk for the smallest recognizable unit for measuring physical or mental work. "Gismo" he described as a term for nothing at all.

The simple act of picking up a peg and placing it in a hole, he demonstrated, can be broken down into 18 therbligs. Every one of these that can be eliminated or combined with another motion makes the job simpler for the operator and less costly for the employer.

"Human engineering is as important as tool engineering," the speaker went on, stating that the real challenge is to make happier and better workers, not just to produce more goods.

First step in work simplification is to sell the operator on proposed improvements to his job, in order to obtain his complete cooperation. Most important is to try to eliminate the operation, as many hours may be spent trying to simplify an unnecessary operation.

Raymond A. Freeman, chief engineer of the V & O Press Co., Hudson, N. Y., and a member of Mid-Hudson chapter, was a guest at the meeting.

M. A. Cote, chairman, introduced the speaker and J. P. Cloutier, third vice-chairman, thanked him.

Accepts New Post

Cleveland, Ohio—Douglas H. Compondu has been named industrial representative in the Cleveland area by Warren Refining & Chemical Co., R. S. Geddes, company president, has announced. Mr. Compondu's appointment initiates a new service to users of the firm's lubricants and cutting compounds.

A member of Cleveland chapter, ASTE, Mr. Compondu has had nearly 18 years' experience in tool engineering.

San Diego Chapter Installs Officers at Dinner Dance

San Diego ushered in its new officers with a dinner dance at Caspar's El Rancho. Raymond Peters, outgoing chairman, administers oath of office to, from left: G. S. Bunch, Jr., chairman; Vaughan Pruyne first vice-chairman; Clarence LaCourse, second vice-chairman; Vincent Petricola, secretary; Donald Pedersen, treasurer; Arthur Crom, standards chairman; Mervyn Witmore, education chairman; Gordon Gray, membership chairman; and Angelo Mattei, publicity chairman.

Multiple Spindle Tooling Cuts High Labor Costs

Los Angeles, Calif.—How multiple-spindle tooling can offset problems of high labor costs in mass production was effectively presented to Los Angeles members by Robert R. Rhodehamel, general sales manager of National Acme Co., at a recent chapter meeting in Roger Young Auditorium.

In his illustrated talk Mr. Rhodehamel traced the development of the automatic screw machine from its earliest days to modern multiple-spindle bar and chucking automatics.

R. Gerald Stronks, chapter chairman, presided and introduced his committee chairmen. Addition of an Industrial Relations Committee was announced, with Joseph A. Parks as chairman.

Richardson Transferred

Detroit, Mich.—M. G. Richardson, formerly chief engineer of the Plomb Tool Co. of Los Angeles, has been transferred to Detroit, in charge of industrial sales for Ohio, Indiana and Michigan.

Mr. Richardson, who has been affiliated with the Toledo, South Bend, Elmira and Los Angeles chapters of ASTE, is now a member of Detroit chapter.

Bock, Council President

Columbus, Ohio—W. E. L. Bock, a former chairman of Columbus chapter, ASTE, has been elected president of the Columbus Technical Council, according to a recent announcement.

Mr. Bock was advanced from the vice-presidency of the organization of 15 central Ohio technical societies.

Experience Best Teacher In Designing of Dies

Cedar Rapids, Iowa—Die design is not a science but rather an art, obtained only through experience, since the many variable and uncontrollable factors cannot be covered by set rules and formulas.

Professor Rusinoff of the Illinois Institute of Technology made this assertion in an address to Cedar Rapids chapter. The professor was technical speaker at a dinner meeting, May 18, at the Montrose Hotel, attended by 35 members and 29 guests.

In reviewing the history of press work, he stated that this method of processing did not gain recognition until the first world war. Then it made important strides in the automotive industry, largest user of parts produced in presses.

Have Advantages Over Castings

Through industrial research and engineering, many new applications of pressed metal parts have been developed. These often replace castings, the speaker said, due to superior strength, improved appearance and reduced cost.

While discussing the importance of metallurgy, both in dies and in the parts produced, Professor Rusinoff described die steels and heat treatments in various applications. He touched on carbide dies, problems and costs in their manufacture and damage through misuse. Production runs, he observed, must be in tens of thousands to justify the use of carbide dies.

Non-metallic materials, such as rubber, Kirksite and Masonite can be used for dies on low production runs of thin steel and non-ferrous metals and alloys. The aircraft industry, the speaker indicated, is the largest user of dies of this type.

The professor also mentioned ways of reducing cost and waste in die and material layout.

Following this formal talk Professor Rusinoff conducted an animated question and answer period.

Before the technical session, the highly controversial subject, "Do Correspondence Schools Help Industry?" was discussed informatively by E. G. Johnson of the American School, Chicago, Ill.

Chairman John L. Stark presided and introduced the speakers. During the meeting forms were distributed to survey the membership on program topics for the coming season.

Exhibits Cutaway Models Of Hydraulic Equipment

Toledo, Ohio—H. L. Stewart, assistant sales manager of the Logansport Machine Co., Inc., discussed "Fluid Power in Action" at a recent meeting of Toledo chapter at the Toledo Yacht Club.

Mr. Stewart touched briefly on many phases and possibilities of hydraulic equipment for controlling fluid power. Slides showing hydraulic circuits and machines illustrated his talk, and cutaway models of valves, cylinders and other hydraulic and air equipment were displayed.

A question and answer period followed.

Mrs. Reinhold Lang, fashion authority from Kitchener, Ont., discusses dress styling in North America and abroad at Hamilton chapter's annual ladies night.

ASTE Ladies Hear Fashion Authority

Hamilton, Ont.—The subject of designing took a new twist at Hamilton chapter's ladies night, May 13, when Mrs. Reinhold Lang of Magda Lang Dresses, Kitchener, compared dress styling and living standards in Europe, Canada and the United States.

A world traveler and fashion authority, Mrs. Lang described fashion shows held in London, Paris and New York, including one occasion when she met members of the British royal family.

Gordon Hall, immediate past chairman, introduced Mrs. Lang. William Shaw, third vice-chairman, thanked her for her presentation.

On behalf of the chapter Chairman George Gilmour presented a Royal Doulton figure to Mrs. Gordon Hall. Door prizes were distributed to several women guests.

During the dinner preceding the evening program, First Vice-Chairman George Churchill proposed a toast to the ladies and Mrs. Churchill responded. The meeting at Fischer's Hotel was the last of the season.

Geologist Names Sources Of Native Minerals

Springfield, Mass.—Fifty New England tool engineers learned something about the contents of the rocks so plentiful in their terrain, when Prof. Leo D. Otis, curator of the department of geology at the Springfield Museum of Natural History, addressed the local chapter at a meeting in Rovelli's Restaurant, May 9.

Professor Otis, who heads the Connecticut Valley Mineral Club, showed specimens of surprisingly varied minerals found in New England. Relating where these natural resources may be located and in what quantities, he gave interesting sidelights on the history of former mineral production ventures.

Prior to Professor Otis' lecture, Wendell Ingham, vice-chairman, delighted the audience with an unannounced talk on "Tieing Flies for the Grand Old Sport of Fishing."

An executive board meeting, to formulate plans for the year's activities, followed the chapter meeting.

Rainey Cites Improvements in Leather Oil Seals

San Francisco, Calif.—Speed and temperature study is of utmost importance when contemplating application of oil seals, to meet the demands of modern high-speed mechanisms.

R. S. Rainey, chief engineer of National Motor Bearing Co., Inc., Redwood City, pointed this out to Golden Gate members during a chapter meeting, May 17, at Magnolia Restaurant, San Mateo.

In his lecture, "Manufacture and Application of Oil Seals," Mr. Rainey stated that 80 percent of all seals manufactured are the metal-encased single spring loaded type.

This seal is made with leather, rubber or synthetic sealing members. The former, most commonly used, are indicated for slow speeds, low temperatures and heavy duty machinery where finishes are not the best. It is of rugged construction to meet rough assembly practices.

Efficiency Greatly Improved

Through recent developments in tannages, shapes of sealing members, trimming methods and molding practices, performance of the leather seal has been improved 30-40 percent. It is now capable of operating continuously at temperatures above 200° F, can stand peripheral speeds up to 2000 fpm, and has considerable life on machinery with shaft finishes as rough as 50-60 rms.

Synthetic single member spring loaded seals, Mr. Rainey continued, have had the most development in the past few years. These seals are generally specified on all high-speed applications such as engines and pinions, transmission and gear drives of all kinds.

The speaker gave the following rule of thumb for designers wishing to operate seals at 3000 rpm or above: surrounding temperature not over 200° F; runout not over 0.010; shaft surfaces finished to not over 20 rms. Shaft whip and jump should be avoided by mounting the seal close to the bearing. For best results the seal should be relieved so no pressure can build up in the bearing area. The ID-OD relationship of the seal itself should be sufficient for maximum cooling.

Pressure and abrasion conditions are other factors which require study in the application of either standard or special-design oil seals. In most cases standard seals are available or can be modified to meet conditions, Mr. Rainey added.

The meeting concluded with a discussion and question session.

* * *

The previous meeting featured Robert R. Rhodehamel, multiple spindle tooling specialist from National Acme Co., Cleveland, Ohio.

Mr. Rhodehamel showed and explained slides depicting tooling setups used on multiple spindle automatic screw machines. He also detailed setup and operation of special purpose attachments.

Interest of the audience was evident in the questions asked following the talk.

Chairman James V. Coulter presided and, after brief reports of committee chairmen, announced the appointment of Past Chairman Edward J. Raves to the National Program Committee. Chapter committee chairmen reported briefly on their activities.

Eighty-five members and guests attended the dinner meeting at El Curtola Cafe, Oakland.

Induction Heating Method Demonstrated in Slides

Erie, Pa.—May 3 meeting of Erie chapter followed a smorgasbord dinner at the General Electric Community center.

Chairman A. E. Weingard introduced the technical speaker, Dr. H. B. Osborn, Jr., technical director of Tocco Div., Ohio Crankshaft Co., Cleveland, Ohio, who lectured on Induction Heating.

Illustrated with slides showing depth of hardness of parts processed by the induction method, his talk included the history and development of equipment for this hardening operation. A question and answer period followed.

Chairman Weingard announced that Second Vice-Chairman John Van Kampen had resigned for business reasons. A former sales representative of Walter J. Greenleaf & Co., Mr. Kampen has recently become sales manager of the Wisconsin Drill Head Co.

Among the 40 members and 29 guests attending the meeting were the following ASTE visitors: G. W. Remensnyder, Buffalo, and F. T. Lyons, Syracuse, N. Y.; Larry Lang, Detroit, Mich.; W. J. Linhart, Cleveland, Ohio; and Gay Wood, Pittsburgh.

Roy Ackerman (left), Evansville program chairman, introduces Walter Haag of Servel, Inc., technical speaker at a recent chapter meeting.

Urges Safety Features In Die, Fixture Design

Evansville, Ind.—Tool engineers should include safety factors in the design of dies and fixtures instead of depending on the operator to add these features, Walter Haag, safety director of Servel, Inc., told Evansville members.

Mr. Haag spoke on this subject at a meeting May 9 in the Science and Engineering Building of Evansville College.

In conjunction with his address, Mr. Haag presented a sound film, "Steel—Man's Servant." A production of the United States Steel Corp., the motion picture showed the drama of steel making from ore mining to rolling mill.

A crowd gathers around H. L. Stewart of Logansport Machine Co. as he demonstrates hydraulic display units after lecture at Philadelphia chapter on operation and application of hydraulic equipment.

Hydraulics Challenge Designer's Ingenuity

Philadelphia, Pa.—The value of hydraulics is limited only by the ingenuity of design and production personnel, H. L. Stewart, research and development engineer of Logansport Machine Co., Logansport, Ind., asserted in a lecture before Philadelphia chapter, May 19.

Examples cited by Mr. Stewart included such varied applications as in lathe chucking, manufacture of water faucets and sizing of bacon. He described the use of hydraulics in remote control systems and safety circuits.

When making an installation, air compressor capacity, cycle frequency, operating conditions and ultimate installation cost should be considered, he cautioned. Lines should be planned to eliminate friction, using as few bends as possible to prevent scale or dirt accumulations.

Importance of clean oil, filters, and instructions on tags affixed to the equipment were stressed. The speaker also mentioned the use of "O" rings and improvements in rod packings and wipers.

Emil Kitzman, chairman, presided and announced the appointment of L. S. Paulsen, first vice-chairman, as superintendent of manufacturing departments at the Hunting Park Avenue plant of Link-Belt Co.

Members were informed of the death of Member Ernest Pohlmann of Franklin Institute. Plans were outlined for the annual Executives Night to be held in September at the Broadwood Hotel.

Reminding the group that ASTE building fund participation certificates are still available, K. W. Riddle, second vice-chairman, advised consideration of these investment offerings.

Mr. Riddle introduced Henry Smithgall, standards chairman, who explained his committee's organization. With appointees representing ten leading fields, this committee will endeavor to provide a consulting information service and will work toward promoting the establishment of ASTE standards.

H. W. Gross, past chairman, offered the dinner invocation, and Edward Chambers furnished a piano accompaniment for group singing during the meal.

Lists Prime Reasons For Steel Failure

Pittsburgh, Pa.—There are five basic reasons for tool steel failure, Dr. S. G. Fletcher, chief metallurgist for the Latrobe Electric Steel Co., Latrobe, Pa., told Pittsburgh chapter at a dinner meeting held May 6 at Fort Pitt Hotel.

These difficulties concerning tool steel and its use in dies are: (1) wrong type and grade of tool steel; (2) defects in the steel; (3) poor die design; (4) complete mishandling of finished die; and (5) improper heat treatment of finished die, which may result in strains and final failure.

During his slide-illustrated lecture and in the subsequent question period, Dr. Fletcher explained these factors in detail.

Ray P. Kells, chief service engineer for the same company, assisted Dr. Fletcher in his presentation.

Chairman Frank T. Boyd presided and called on committee chairmen for reports. The Membership Committee announced plans for securing new and active members and for rechecking existing membership records.

Approximately 80 members and guests attended the meeting.

Obituary

Fred E. Pohlmann

Fred E. Pohlmann, 66, a research engineer for the Franklin Institute in Philadelphia, Pa., died May 16 at Lankenau Hospital there.

Mr. Pohlmann had been with the institute for the past two years and was previously employed by the William Sellers Co.

Born in Germany, he learned his trade as machinist and was employed at the Krupp Munitions Works before emigrating to the United States in 1921. In this country he became associated with Schutte & Koerting Co. at the Cornwall plant where he served as draftsman and designer until joining the Sellers firm in 1931 as machine tool designer.

For the past nine years he had been an active member of Philadelphia chapter.

Multi-Spindle Machine Saves Handling Time

Springfield, Vt.—At the closing meeting of the season, held May 11 at Trade Winds Cafe, Twin States members heard Creighton Audette, assistant sales manager for Cone Automatic Machine Co., Windsor, Vt., review the history, development and advantages of multi-spindle automatic screw machines.

As he outlined the evolution of the modern multi-spindle automatic from the first single-spindle machine invented about a century ago, Mr. Audette showed slides of photographs and drawings of some of the earliest machines.

He emphasized that the greatest economy in using multi-spindle machines is in elimination of handling time.

Citing instances where tooling had effected savings, he mentioned one job for a mechanic's universal joint where an automatic multiple-spindle machine saved its cost during the first month.

Among several setups described was one including heat treating of the part on the machine in addition to other operations. The speaker also showed slides of the Davenport machine, claimed to be one of the fastest production machines in use.

In a question period following his talk, Mr. Audette brought out further developments in the field of automatics. About 35 members and guests were present.

Story of Broaching Told in Color Film

Louisville, Ky.—In color film Louisville members saw the advancement of broaching from hammer drive broaches to modern hydraulic machines. The motion pictures, presented by Harry Gotberg, chief engineer for Colonial Broach Co., Detroit, Mich., illustrated his lecture, "Modern Broaching Methods," given May 11 during a chapter dinner meeting at Kentucky Hotel.

Mr. Gotberg's discussion also included the design of broaches for various applications.

Enthused with the advantages of broaching in machining metals, as presented by the speaker, the audience asked numerous questions concerning problems in their own plants.

N. H. Booker, chairman, presided. Sauter F. Reichert, first vice-chairman, introduced the speaker to the approximately 75 members and guests present.

Coming Meetings

CLEVELAND—August. Annual Family Picnic. September. Trip to Detroit Arsenal to see new General Patton tank.

DETROIT—August 6. Golf Party, Indianwood Golf and Country Club, Lake Orion, Mich.

MONTREAL—October 27, 28, 29. ASTE 17th Semi-Annual Meeting.

SPRINGFIELD (MASS.)—August. Clambake.

TOOLS OF TODAY

Micromatic Hone Exhibits Recent Developments

Marking 20 years of honing progress at a recent showing at the plant, 8100 Schoolcraft Ave., Detroit, the Micromatic Hone Corporation gave visitors a working demonstration of the company's latest developments in precision honing equipment. A few of these machines are illustrated below.

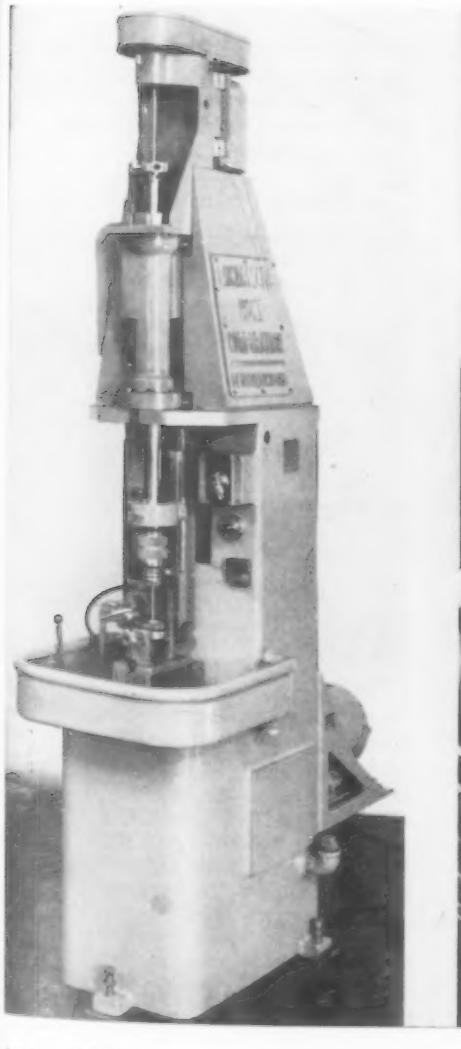
Shown at left is the Model 736 Hydrohoner, designed for microhoning small parts. Featuring simplicity and ease of operation, the machine is said to hone to tolerances within millionths of an inch. On the part shown set up, size was being held to 0.0001 in. on the diameter with geometric accuracy held to 0.000025 in.

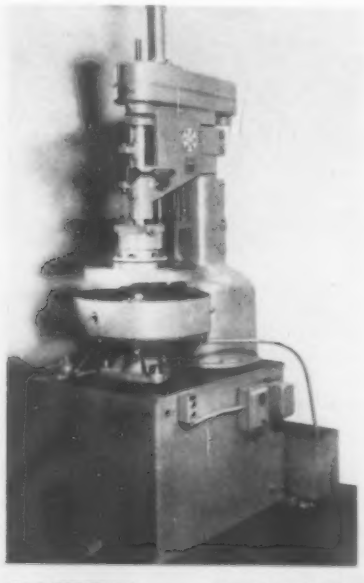
At the upper center is shown Model 821-2 Microflat Machine, a production machine for finishing two surfaces simultaneously. As set up, the machine is finishing thrust plates, mounted in four carrier rings that rotate around a sun gear while turning about their own centers. From 12 to 20 parts are finished in one operation at a production rate of about 800 per hour. Faces held parallel within 0.0001 in., finish to 10 Microinch RMS.

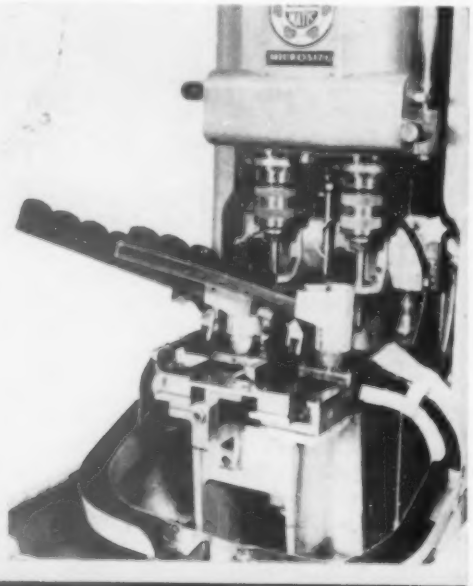
The machine shown at upper right is Model 705-2 Hydrohoner, a double-spindle machine equipped with Micro-size automatic sizing and magazine feed. Operation of the machine is entirely automatic; for example, the gears shown are automatically dropped into the fixture, honed and ejected at a rate of approximately 300 per hour. Size is held to less than 0.0003 in. tolerance by electronic control.

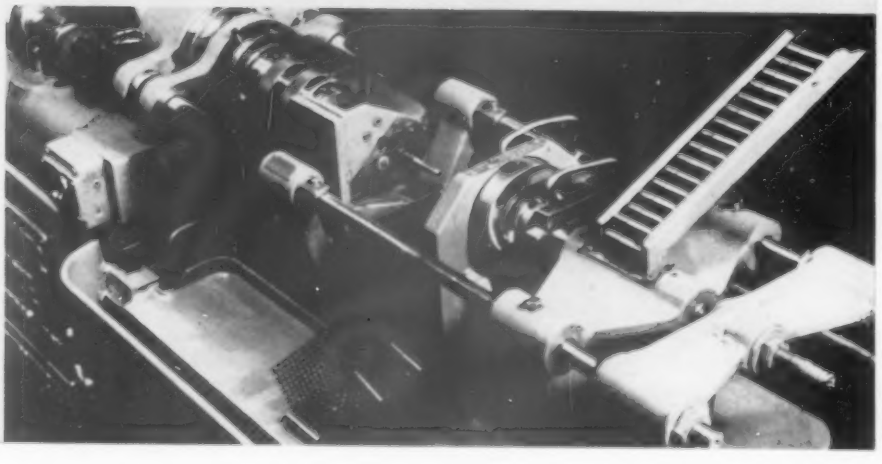
The lower photo shows the "works" of Model 523 Hydrohoner, a quill-type horizontal machine, here set up to hone valve guides. Here, too, operation is entirely automatic, with production around 250 per hour and with dimensional tolerances comparable to those stated above. The machines illustrated are typical examples of precision honing equipment manufactured by Micromatic Hone Corporation.

Since its introduction to industry a couple of decades ago, honing has contributed remarkably to the quality of present-day products. As contrasted to lapping, which tends to charge cast-iron surfaces, honing actually cuts and produces curled chips comparable to those produced by diamond boring. This phase of the process alone has increased the life of automobile engines from a few thousand miles, when reconditioning was necessary, to what is practically the life of the car. And the honing industry is still in its infancy! **T-7-1**









4-Way Air Control Valve

A 3-position, double, 4-way Air Control Valve—the Logan Model No. 50—

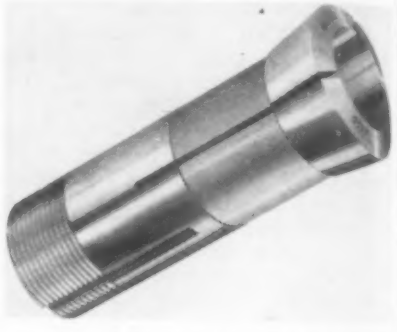
for operating two double-acting air cylinders, has been announced by the Logansport Machine Co., Inc., Logansport, Ind. The valve, of packless plug-type construction, is designed for long life with minimum maintenance. All working parts may be removed without disconnecting air pipe lines. Exhaust and intake ports are on opposite sides, each grouped with two cylinder ports. All six ports are tapped for ¼ in. pipe.

With the valve handle in first position, the inlet is connected to cylinder ports Nos. 2 and 3, and the exhaust to cylinder ports Nos 1 and 4. In the second position, the inlet is connected to cylinder ports 2 and 4, and the exhaust to cylinder ports 1 and 3. In the third position, the inlet is connected to cylinder ports 1 and 4, and the exhaust to cylinder ports No. 2 and No. 3. Among many effective uses, claimed for this valve, is applications requiring a chucking cylinder to operate in sequence with a tail stock cylinder.

T-7-2

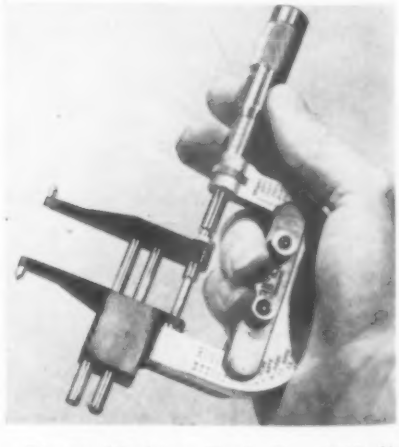
Improved Spring Collets

The Wade Tool Co., Waltham, Mass. announces that, from now on, all collets manufactured by the company will have their threads ground from the solid, after hardening, to provide against possible distortion in thread pitch, thread shape, and concentricity.



Wade collets also feature the buttress thread which, by presenting mating surface at right angles to the pulling force, eliminates any expanding tendency and provides maximum strength and security. Another feature claimed is the Wade collet seal, which entirely closes the slots and gives protection from chips and other materials which might otherwise enter the slots and create a problem. T-7-3

Improved Microdapter



Rimat Machine Tool Co., 1117 Air Way, Glendale, Calif., announces an improved model of the Microdapter—the attachment for outside micrometers designed to permit taking precision internal measurements in locations ordinarily inconvenient or inaccessible to conventional inside micrometer sets. The attachment clamps securely to any micrometer frame and measurements are read directly on the regular thimble with original micrometer accuracy. Once set, measurements are duplicated with any micrometer. T-7-4

The Monthly Robertson Bulletin

FOUR HOURS ON BLANCHARDS WITHOUT A SQUEAL

We were delighted when an electrical manufacturer said to us recently, "Let's see what this Robertson Segmental Wheel can do."

We were delighted because we know that people who thoroughly test Robertsons in their own shops soon become enthusiastic users—and boosters—of these unique wheels.

For four hours, this manufacturer ran everything in his shop through on the Blanchard—boiler plate, Neor, Hampden, cold-rolled and Hi-Carbon Hi-Chrome steel. The wheel—an 18″ x 5″ x 15″ WA301-H3V—took the work in its stride. The only difficulty experienced was "squealing" on boiler plate 24″ x 10″ x ½″ thick. This was eliminated when table speed was increased from 6 to 12 rpm. Other than that, the entire test was run at 12 rpm with .012″ down feed per minute.

On one Hi-Carbon Hi-Chrome die, of 65 Rockwell hardness, the work covered approximately one-third of the chuck area. In 15 minutes, .050″ stock was removed.

Wheel wear at the end of four hours' grinding was ⅛″. The Robertson wheel was ½″ narrower and required less dressing than former wheels used by this manufacturer. It gave longer life at lower wheel cost.

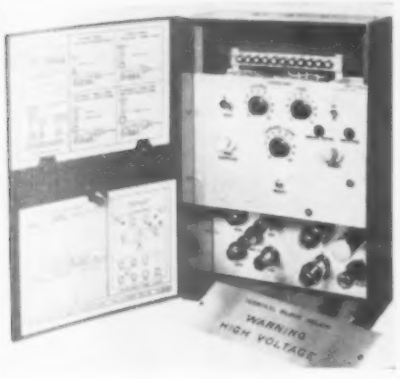
We invite *you* to give Robertson Cool-Cut Wheels the acid test at any time. Put them to work side by side with other wheels. You'll be delighted at their ability to increase production at lower wheel cost—and you'll like the substantial bonus in decreased power consumption they make possible.

ROBERTSON MANUFACTURING COMPANY

TRENTON 5, NEW JERSEY

Resin-Bonded and Vitrified-Bonded Grinding Wheels • Mounted Wheels • Segments

Electronic Overload Control



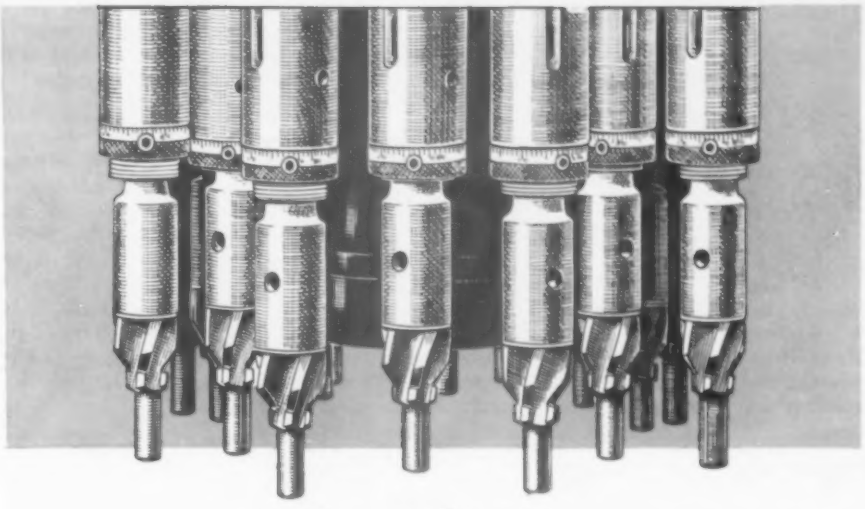
The Brinnell Co., Granby, Conn., announces an improved Prolectron—the PN123—operating on normal loads from 1 to 100 amperes, or more with addition of a small current transformer. Among features claimed for this model, which replaces three former models, are a "normal load finder" designed to eliminate need for taking ammeter readings for setting the unit when tool changes vary the normal load; also that, while unit supply voltages of 110 or 220 v can be handled, it will operate on drive circuits of 100, 220, 440 and 550 v, 60 cycle. Full particulars on a free trial may be had by writing on company letterhead. **T-7-5**

Oil Circulating Head

A fixed center Oil Circulating head, by U. S. Drill Head Co., Cincinnati 4, Ohio, has been designed mainly for high speeds although it is also used for large cluster boxes on way-type machines. For example, the 34 spindle unit in a 6 in. square head, shown, is said to have been operated successfully at 10,000 rpm with comparatively little heat.

The head contains a built-in vane-type pump, which pumps the oil to the top of the head and, by centrifugal force, spreads over its entire upper surface, then cascades down over the bearings and gears. The unit is to be ideal for high speed sensitive drilling machines. **T-7-6**

Turn to Page 82 for Handy Tools of Today Coupon



NOW . . . a *new* Gairing MICRO-NUT

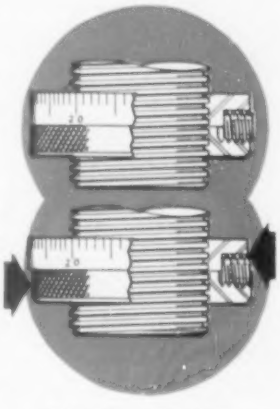
THE "FUL-GRIP" IS ACCURATE, COMPACT, ECONOMICAL

GAIRING who, years ago, was first to make a micrometer adjusting nut under the name of Micro-Nut, offers a completely new, much improved version: the GAIRING FUL-GRIP MICRO-NUT, much lower priced.

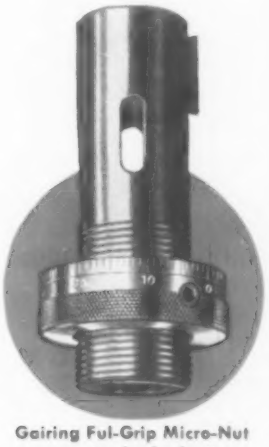
Fitting all standard adapters, with or without keyways, it provides a *full grip* between the thread angles of nut and adapter or other threaded tool shank.

Made in two pieces permanently assembled, this nut may be freely moved up and down along the threads to its approximate position. (No spanner wrench is required to move nut on threads). A mark is then made on the spindle opposite the .001" graduation provided on the nut. From that point on adjustment may be made to well within .001". When set, the Allen screw in the nut is tightened.

This set screw does not come in contact with the thread on the adapter, where it might cause damage. It merely alters the relation between top and bottom halves of the nut, and causes a tight grip on the angle of the threads all around, giving perfect parallel contact between top of nut and end of machine spindle.



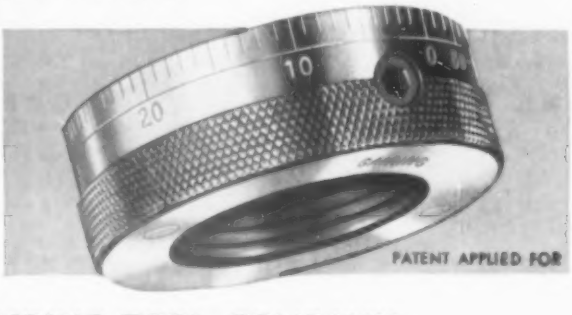
Tightening of Allen screw moves top and bottom parts of nut in opposite directions, giving full grip on threads all around



Gairing Ful-Grip Micro-Nut on a standard adapter

On drill heads and multiple spindle set-ups, Micro-Nuts are everywhere replacing the standard adjusting nut. They accurately set tools to correct depths and permit quick and accurate individual adjustment, after replacement or regrinding.

Gairing Ful-Grip Micro-Nuts are a well engineered answer to this widely felt need. They will retain their true diameters, as the rings are solid and threads uninterrupted. Made in standard sizes ¾" to 1⅞" with National Acme Thread. V-thread is made to order only. Write for literature.



GAIRING TOOLS

THE GAIRING TOOL COMPANY
21223 Hoover Road, Detroit 32, Mich.

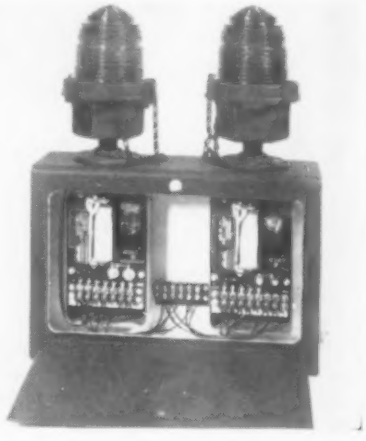
Dualock Thread Ring Gages

"Go" and "No Go" carbide "Dualock" adjustable thread Ring Gages, by Pratt & Whitney Division, Niles-Bement-Pond Co., West Hartford, Conn., have been developed for long production runs where continued accuracy must be maintained. They are designed to eliminate the hazard of gage wear on close tolerance work and are said to be ideal as master or reference gages.

Having the same AGD locking mechanism as steel thread rings, they are nevertheless said to greatly outwear the steel gages. They are relieved at the major diameter, to preclude possibility interference and to assure required contact as the thread flanks but not on the crest or root. They are further convoluted on both ends to remove partial threads up to start of full thread, and are precision lapped to remove grinding marks and irregularities on the thread flanks. **T-7-7**

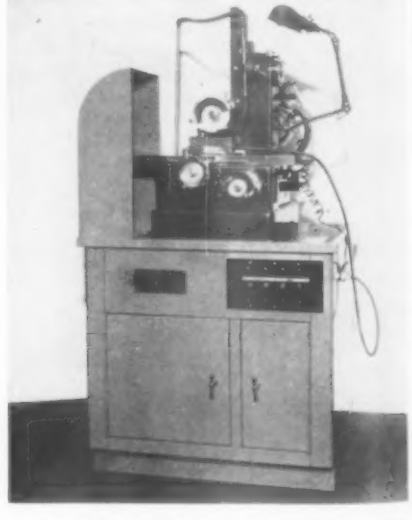
P&W Light Signal Device

A self-contained Light Signal Device, to be used with the P&W Model D Electrolimit Continuous Gage or "flying mike", announced by the Pratt & Whitney Division, Niles-Bement-Pond Co., West Hartford, Conn., signals the operator of a rolling mill, a continuous inspection line, or a shear, by means of lights when the strip material is "off gage". Or, it can be used to control an external circuit for classifying.

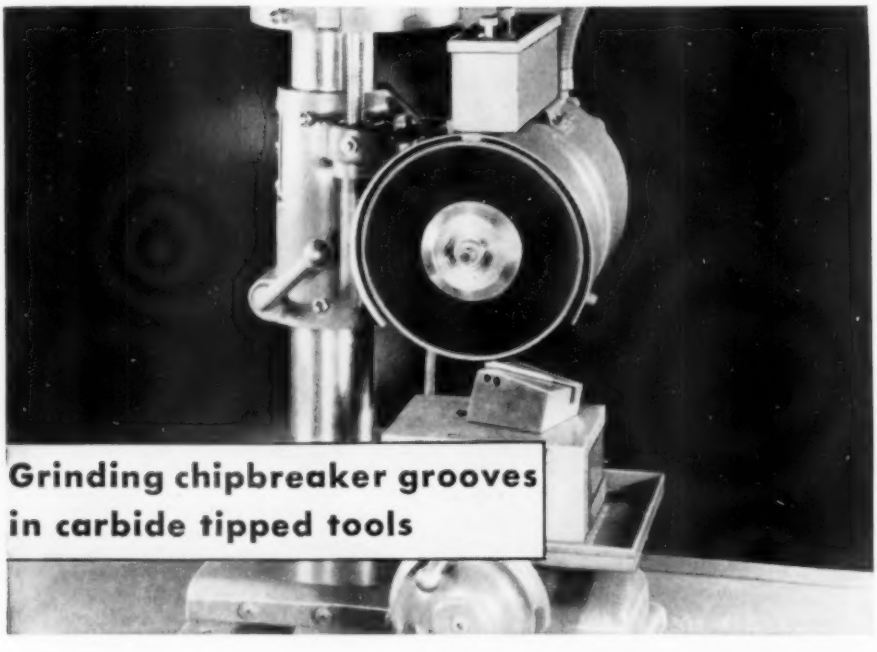


The device consists of one red and one green lantern, two electronic relays and a suitable mounting case. The limits are set on the contact meter and, when plus and minus limits are exceeded, an electric contact is made through the relays, thus providing a control circuit which can be used to control mechanisms and lighting lights. **T-7-8**

Sensitive Surface Grinder



A sensitive Surface Grinder especially designed for tool makers and small parts grinding, by the Jakobsen Tool Co., 217 Glenwood Ave., Bloomfield, N. J., is said to be so sensitive that it splits tenths yet can be used for heavy roughing. Among features claimed, it has variable wheel speeds to give maximum flexibility, grinds with wheel diameters from 1/16 to 5 in. or more, and incorporates a coolant system that can be thrown on the work from almost any angle. **T-7-9**



with MANHATTAN DIAMOND WHEELS

Exclusive Manhattan bonding also permits the grinding of soft or hardened steel shanks in conjunction with grinding carbide inserts without loading or glazing.

Unexcelled for precision grinding of Carbides on surface, cylindrical or internal operations.

NO DRESSING **GREATER ECONOMY**

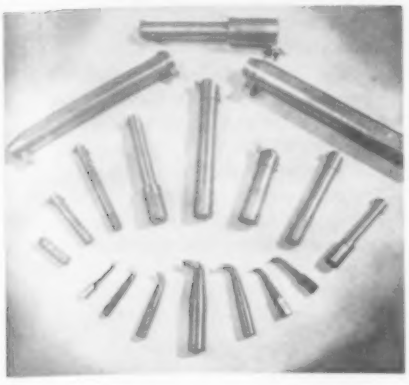
DIAMOND WHEEL DEPARTMENT

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

Bits and Boring Bars



The Maxwell Company, 250 Broadway, Bedford, Ohio, announces a standard line of Forged Bits and Boring Bars, all fitting any standard tool holder and designed for boring, facing, recessing and other similar operations.

Of 18-4-1 high-speed steel, the forged bits are available on order in shank sizes from $\frac{3}{8}$ to 1 in. in increments of $\frac{1}{8}$ in., with minimum boring capacity down to $\frac{1}{4}$ in. for the $\frac{3}{8}$ in. shank size. In addition, these tools offer a selection of maximum depths for each of the various shank sizes.

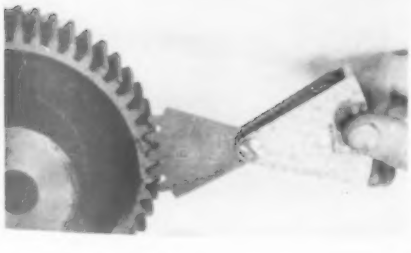
The boring bars, made from alloy tool steel, are available in shank sizes from $\frac{1}{2}$ to 1-$\frac{1}{2}$ in. in increments of $\frac{1}{4}$ in., and can be furnished with either straight or angular insertable bits. Standard cutter angle is 60 deg, with 45 deg cutter angle also available. Like the forged bits, they can be furnished in a wide variety of minimum bore and maximum depths.

Catalog 1-FB and 1-BB give available sizes of both bits and boring bars.

T-7-10

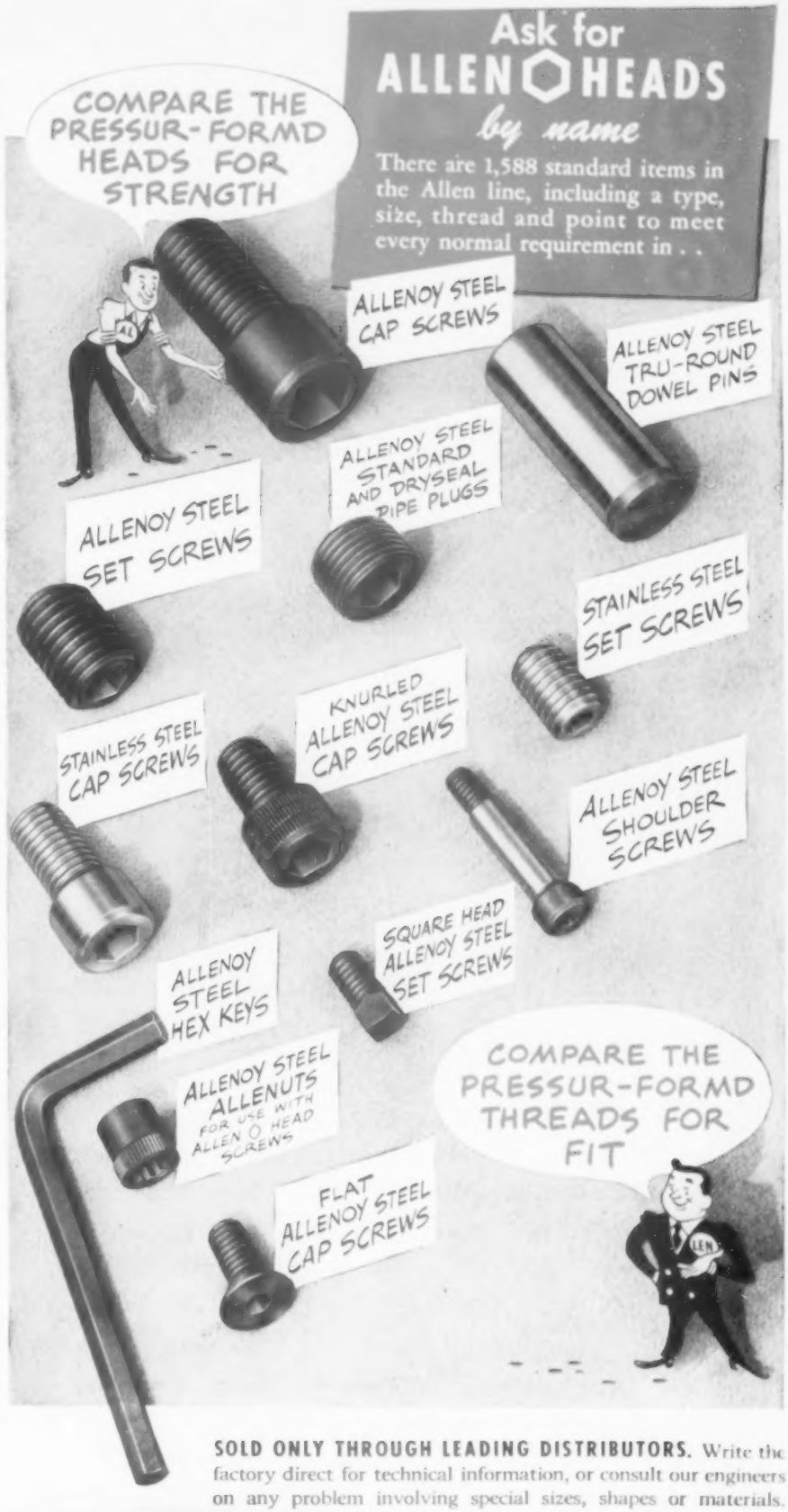
Gear Gage for Shop Use

A Gear Gage designed especially for shop use has been added to the line of gear testing equipment and percision to tools manufactured and distributed by the George Scheer Co., Inc., New York 12, N. Y. This shop model has 23 blades of the diametrical pitches ranging from 4 to 64 pitch in 14½ deg. pressure angles.



The teeth are of the correct involute shape, machined with the aid of special fixtures by the Fellows Gear-Shaper Generating Method, and segment blanks of each pitch are first turned in fixtures to conform to the full diameter in accordance with the number of teeth for the full circle.

T-7-11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ALLEN HEADS
by name
There are 1,588 standard items in the Allen line, including a type, size, thread and point to meet every normal requirement in . .
COMPARE THE PRESSUR-FORMD HEADS FOR STRENGTH
ALLENOY STEEL CAP SCREWS
ALLENOY STEEL TRU-ROUND DOWEL PINS
ALLENOY STEEL STANDARD AND DRYSEAL PIPE PLUGS
ALLENOY STEEL SET SCREWS
STAINLESS STEEL SET SCREWS
KNURLED ALLENOY STEEL CAP SCREWS
STAINLESS STEEL CAP SCREWS
ALLENOY STEEL SHOULDER SCREWS
SQUARE HEAD ALLENOY STEEL SET SCREWS
ALLENOY STEEL HEX KEYS
ALLENOY STEEL ALLENUTS FOR USE WITH ALLEN HEAD SCREWS
FLAT ALLENOY STEEL CAP SCREWS
COMPARE THE PRESSUR-FORMD THREADS FOR FIT

SOLD ONLY THROUGH LEADING DISTRIBUTORS. Write the factory direct for technical information, or consult our engineers on any problem involving special sizes, shapes or materials.

WARNING
Allen-Type screws aren't necessarily Allen-Made.
Get genuine "Pressur-Formd" Allen Head screws in this black and silver box.

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Sounds as though we're pulling your leg but we're as serious as the chip manufacturer who uses an Ames No. 516 Thickness Measure to constantly check potato slice thickness, thereby controlling material costs and assuring a finished product that is always tops in quality and appeal.

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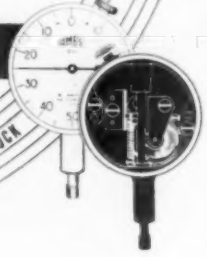


Electronic Comparator

An Electronic Comparator, designed to provide accurate surface control of machined parts as quickly and easily as routine dimensional checking, is announced by the Merz Engineering Company, Indianapolis, In. Operating from any 100 v. 60. cycle outlet, the unit—the Merz Pico Surface Comparator—checks surfaces electronically against an approved sample to assure instant and accurate meter readings.

Simple, compact and portable, it can be used handily anywhere on the production line and, as claimed, without special accessory equipment or specially skilled operators. It is entirely self-contained and complete with carrying handle and a storage drawer in the back of the aluminum case.

The Comparator consists of meter, exploring head and adapter. Readings are taken in 5 seconds by pressing the head against the surface being checked and touching the actuating button to compare the meter reading against the Master reading. A knife-edge meter pointer, which reads only one point on the scale, eliminates calculations or averaging. Another feature is the area of exploration—said to be some 500,000 times greater than with tracer methods.

T-7-12

Carbide-Tipped Saw Blades

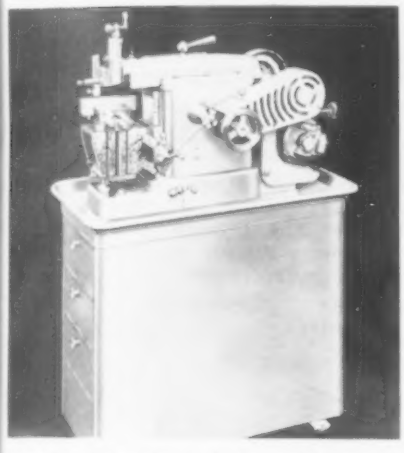
Added to the regular line of Triple-Chip segmental and solid saw blades by the Motch & Merryweather Machinery Co., 1350 E. 222nd St., Cleveland, Ohio, is a line of carbide-tipped and cast-alloy-tipped Saw Blades.

These blades, available in segmental or solid types, have either Triple-Chip or Special tooth grind. Segmental-tipped blades are made in sizes up to 18 in., also to customer specifications or for special production requirements. These blades are recommended for the sawing of plastics and non-ferrous materials and also for milling of ferrous and non-ferrous materials. T-7-13

7 in. Precision Bench Shaper

A 7 in. Bench Shaper for toolroom and industrial use has been announced by the South Bend Lathe Works. Built to standards comparable to the line of South Bend Lathes, this shaper is said to be capable of exacting work on parts within its capacity.

Main castings are of close-grained semi-steel, with ram and table slides milled and hand-scraped for precision fit and provided with adjustable gibs. The ram is 18 in. long, has ample bearing rigidity in all positions and ram stroke is closely adjustable through its range of 0 to 7 in. Cutting speed is variable from 3 to 114 fpm, with stroke rates of 42, 75, 120, and 195 per minute obtained by shifting a V-belt on 4-step cone pulleys.



Cutting position of the tool is adjusted by releasing the rocker arm assembly lock on the ram. The tool head has 3 in. feed, swivels to any angle, has a positive lock and swivel clapper box. A graduated collar on the feed screw reads in thousandths of an inch. The tool post takes tools with shanks $\frac{3}{8}$ in. x $\frac{7}{8}$ in., and the work table, $5\frac{7}{16}$ x 5 x 6 in. deep, is slotted on top and sides, has holes for attaching the vise and special work clamps in various positions, and is equipped with an adjustable outboard support to the base. Reversible power cross-feeds for the table range from .002 to .016 in. per ram stroke. Horizontal table travel is $9\frac{1}{2}$ in., vertical travel 5 in., and maximum distance from table to ram is $5\frac{1}{2}$ in. The vise has a graduated base and swivels to any angle. Vise jaws are 4 in. wide, 1 in. deep and open to 4 in. Complete information, specifications, and prices may be had from the South Bend Lathe Works, 417 E. Madison St., South Bend 22, Ind. **T-7-14**

Water Wash Compound

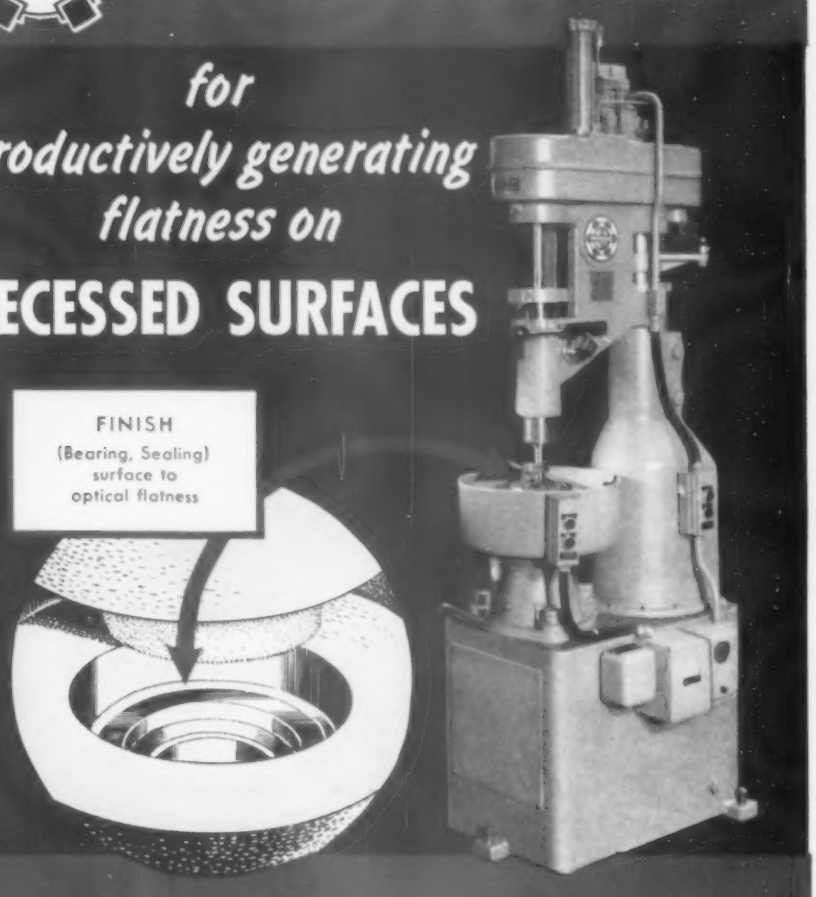
A Water Wash Compound—Northwest No. 1—for paint spray booths that lubricates the overspray, is announced by Northwest Chemical Co., 9310 Roselawn Ave., Detroit 4, Mich. The compound is said to coat each particle of paint with a non-volatile solvent, so that any overspray so lubricated won't stick to the back curtain or to any of the eliminators. **T-7-15**

MICRO MATIC

MICROFLAT

for productively generating flatness on

RECESSED SURFACES



● Microflat machines may be equipped to finish recessed surfaces.

The location of a surface does not limit the application of the MICROFLAT machines. Any surface that can be machined can be finished with this equipment. The surface finish and flatness generated can be controlled and held to any specified requirement.

The machine shown above is equipped with a timer and an air cylinder. The operator loads the part into the fixture and starts the cycle. The fixture rotates, the bonded abrasive finishing surface oscillates and rotates. At the end of a predetermined time cycle the spindle automatically withdraws. Production is 300 pieces per hour.

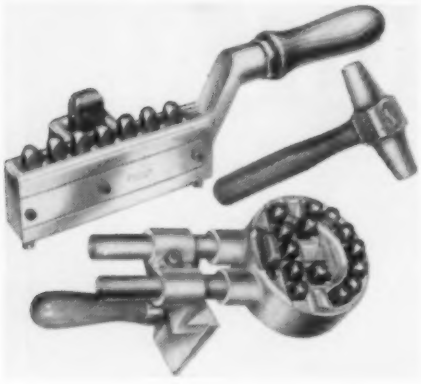
MICROMATIC HONE CORPORATION

8100 SCHOOLCRAFT AVENUE, DETROIT 4, MICHIGAN

DISTRICT FIELD OFFICES:

1323 S. Santa Fe, Los Angeles 21, California — 616 Empire Bldg., 206 S. Main St., Rockford, Ill. — 55 George St., Brantford, Ont., Canada — Micromold Manufacturing Div., Boston Post Road, Guilford, Conn.

Marking Tools



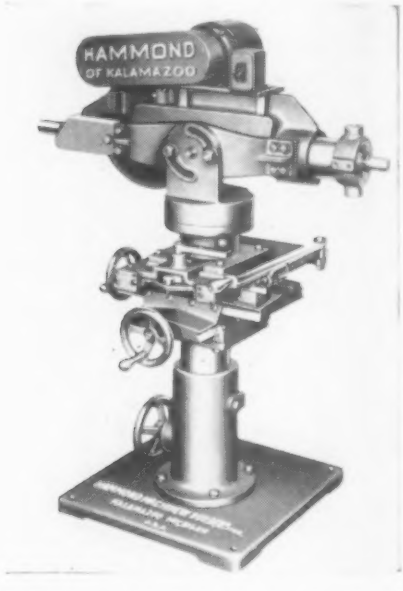
Recent additions to the line of marking devices by M. E. Cunningham Co., 169 E. Carson St., Pittsburgh, Pa., include a streamlined "Safety" Luminum-Line Plate and Pipe Marker—upper illustration—and an Axle End Marker, lower illustration. Holders for both tools are adapted to heavy-duty marking requirements, yet weigh only about half as much as steel holders.

The holders for plate marking are designed with flat bottoms and replaceable metal "feet" which enable them to be moved along hot steel plates without damage to the stamps. Special Vee runners are furnished with the tube and pipe markers to permit positive positioning or round objects; also, top side of the holder has rounded ribs around all stamp holes to resist foul hammer blows.

The standard model Axle End Marker is furnished with any combination of characters and sizes, and is adapted to almost any marking requirement with special setups available on request. Both types of markers incorporate floating friction springs which, in addition to securely holding the shanks, permit their quick removal and replacement. T-7-16

Polish and Buffing Machines

Four single-spindle semi-automatic Polishing and Buffing Machines for use in conjunction with any lathe or contour machine—of which Model SESF is shown—are announced by Hammond of Kalamazoo. Two of these machines are equipped with single rotating spindles, and two with rotating stroke type spindles. These machines are claimed to increase production over hand methods for polishing and buffing with wheels or abrasive belts and backstands several hundred percent on such parts as pots, pans, lamp bodies, hub caps, and plumbing fixtures, to cite a few examples. Novel "Unit" principle of design and features make these semi-automatics simple and versatile in operation.



Other models in Two-Spindle Manual Indexing and Four-Spindle Power Indexing types are also being announced. Complete details may be had from Hammond Machinery Builders, 1629 Douglas Ave., Kalamazoo, Mich. T-7-17

THE HARD
WAY
GETS YOU MORE
Right—gets you more production—more for your money. For long wear and close tolerances specify OHIO WAYS. Uniformly hardened to Rockwell 64 to 66 C scale.
The OHIO KNIFE Co.
CINCINNATI 23, OHIO, U. S. A.

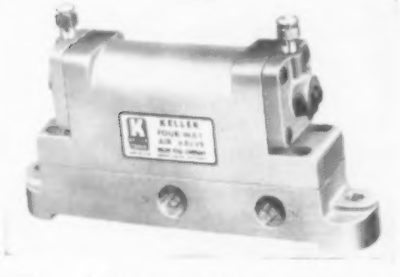
Turn to Page 82
for Handy
Tools of Today
Coupon

Vertical Spindle Shaper

A two-speed Vertical Spindle Shaper, by the Walker-Turner Division, Kearney & Trecker Corp., Plainfield, N. J., features two speeds—7,000 and 11,000 rpm—to provide the correct speed with different size cutters; big table area—22 x 33 in.—to provide ample work space; 3 in. vertical spindle travel with bearing assembly and motor moving as unit; elevating controlled by hand wheel and a graduated dial; independently adjustable guides controlled by hand wheels; and complete guarding for accelerated work speed. **T-7-18**

4-Way Air Valve

Four-way Air Valves of the balanced piston type, announced by Keller Tool Co., Grand Haven, Mich., are designed to control double-acting air cylinders in Keller Airfeedrills as well as for use with other air tools or fixtures requiring fast, accurate control.



The valor is actuated by poppet-type control buttons which exhaust air from either end of a balanced piston, the latter used merely as a means of operating or faced slide valve which forms the actual seal for directional control of air flow.

Design features include a slide valve of molded oil-resistant rubber of which sealing surfaces are said to improve with use; and a stainless steel and therefore rustless piston. Construction is compact and all pipe connections are located in the base so that working parts are accessible without disconnecting the air lines. Available in ¼, ½ and 1 in. pipe sizes, with air capacities of 30, 90 and 350 cubic fpm respectively.

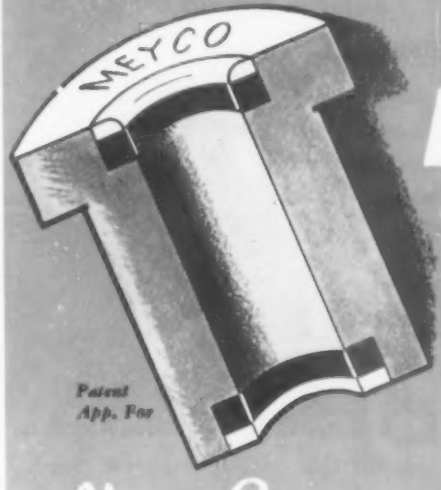
T-7-19

Unit Lift Trucks

Rol-A-Lift models recently announced by the Skarnes Engineering and Supply Co., 2428 Riverside Ave., Minneapolis 6, Minn., are designed to handle crated or uncrated materials and products. The manufacturer claims that the Rol-A-Lift will handle loads too heavy or bulky for fork trucks and will move loads into tight places where neither fork trucks nor cranes can operate.

The units are used in pairs and are moved about like hand trucks. To load a crate, one unit is placed at each end with forks inserted underneath. They are then jacked up, lifting the crate and putting it on wheels, ready to roll. Once in place, the load is lowered gently to the floor at controlled speed.

T-7-20



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MEYCO bushings combine the best features of steel and carbide . . . the protection of steel with the long life of carbide at the points of wear. First cost: higher; end result: substantial savings in production expense. Made to ASA standards . . . MEYCO bushings will SAVE you money. Don't miss *this* bet! Some sizes now available from stock.

Write for bushing catalog No. 13, for further details and a price list.

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"WISE ECONOMY RESULTS FROM WISE SELECTION OF CUTTING FLUIDS"

THE case studies listed below of benefits derived from the soundly engineered application of D. A. Stuart cutting fluids will unquestionably appeal to cost-conscious management and production men. These reports are typical of those received daily.

An Eastern firm operates a special threading machine for simultaneously threading three BX connectors drawn from SAE 1010 sheet. Running at 68 S.F.M., finish was unsatisfactory. A change to D. A. Stuart THREDKUT produced a satisfactory finish and increased production. In addition, die life was increased 3 to 4 hours.

A rifle manufacturer crush dress grinding 8640 roll hardened (Rockwell C40) bolts was obtaining 15-20 pieces between dressings and crushing roll performance was poor. Selection of D. A. Stuart SUPERKOOL 81-X gave them over 300 pieces from one wheel dressing.

It is significant that in both of the above cases, selection of a cutting fluid was made on a basis of *performance*, rather than price or opinion.

Ask to have a D. A. Stuart representative show you how wise selection of cutting fluids can lower your costs.

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North East West South IN INDUSTRY

At the meeting of the board of directors of **Westinghouse Electric Corp.**, **James H. Jewell**, manager of apparatus sales, and **John M. McKibbin**, assistant to vice president and manager of advertising and sales promotion, were elected vice presidents of the corporation. At the same time **Herbert P. MacDonald**, treasury manager in the company's Eastern district office, was elected assistant treasurer.

Robert E. Marshall has been elected secretary of **Worthington Pump and Machinery Corp.** at a recent meeting of the board of directors. Mr. Marshall has been with the corporation since 1942.

J. W. Kinnear, Jr.

Robert E. Marshall

J. W. Kinnear, Jr., has been elected president of **Firth-Sterling Steel and Carbide Corp.**, McKeesport, Pa., manufacturers of high speed steel and cemented carbides. Mr. Kinnear, executive vice president for two years and a director of the company for fifteen years, succeeds L. G. Firth, who has been president since 1933.

J. B. Johnson, vice president and general manager of the **Bryant Chucking Grinder Co.**, has resigned from these positions but will remain as a director of the company. **J. H. Beardsley**, formerly assistant to the president, will become general manager.

Marcel F. DeMuller has been named president of both **Willys-Overland Export Corp.** and **Willys-Overland of Canada, Ltd.**, it was announced by Ward M. Canaday, Willys-Overland board chairman. Mr. DeMuller was formerly vice president and general manager of the Export Corp., and vice president of the Canadian company for several years.

Delmar G. Roos, first vice president of Willys-Overland Motors, was also named to the board of the Export Corp., and **George L. Palmer**, treasurer, was in addition made a vice president.

James H. Goss has been appointed manager of engineering in the control divisions of **General Electric's** Apparatus department, it was announced by K. R. Van Tassel, manager of the control divisions.

Peter P. Ruppe has been named general manager of **Hapman Conveyors, Inc.**, Detroit. Mr. Ruppe was formerly chief engineer for the company.

Dr. Max Hansen, formerly associate professor of metallurgical engineering at Illinois Institute of Technology, has joined the staff of **Armour Research Foundation** of the Institute as senior metallurgist in the non-ferrous section.

Robert F. Myers has been named general sales manager of **The Lees-Bradner Co.**, Cleveland manufacturers of machines for gear and thread generation. Mr. Myers was formerly a sales engineer with the company.

F. O. Dutton has been appointed director of purchases of **E. W. Bliss Co.**, it was announced by Louis C. Edgar, Jr., president. Mr. Dutton was formerly director of purchases for Easy Washing Machine Co., at Syracuse, N. Y.

Gosta Vennerholm, supervisor of **Ford Motor Company's** metallurgical research section of the process engineering laboratory, was awarded the William H. McFadden Gold Medal at a recent meeting of the **American Foundrymen's Society**.

J. F. Roche was elected chairman of the board of **Binks Manufacturing Co.** at the annual meeting of the company. He is succeeded in the presidency by his son, **Burke B. Roche**.

George V. Luerssen, chief metallurgist of the **Carpenter Steel Co.**, was presented the first annual David Ford McFarland Award by the Penn State chapter, **ASM**, at a recent meeting.

Clayton E. Scholes has been appointed general manager of the **Ohio Stainless and Commercial Steel Company's** Osco Steel Division in Detroit. At the same time, **Nate A. Wade** was named assistant manager and **Owen W. Brock** warehouse manager.

A recent open house at the new headquarters of **The Republic Supply Co. of California**, Los Angeles, drew over 5,000 oil and industrial leaders from various sections of the state. Facilities of the company's headquarters include

23,000 sq ft of office space and a 90,000 sq ft warehouse.

Whitman & Barnes, Detroit, moved recently from their previous Detroit location to a new plant and office at 40600 Plymouth Road, Plymouth, Mich. The facilities, built on a 26-acre site, will provide more than a quarter of a million sq ft of floor space.

Albert F. Korf was recently named sales manager of **L. G. S. Spring Clutch Corp.**, Indianapolis, a division of Curtiss-Wright Corp. Mr. Korf was formerly with Allis-Chalmers in various sales capacities.

Ralph M. Johnson, vice president, sales, **Norton Company**, was elected second vice president of the **American Supply and Machinery Manufacturers' Association** at the organization's annual meeting. **C. Leonard Shaw**, publicity manager of Norton, was reappointed to the publicity committee of the group.

OBITUARY

Dana J. Fox, president and treasurer of the **Fretz-Moon Tube Co.**, Butler, Pa., died recently. Mr. Fox joined Fretz-Moon in 1931 as secretary-treasurer, left in 1939 to become assistant treasurer of the National Supply Co., then returned to Fretz-Moon in 1946.

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GOOD READING

A Guide to Significant Books and Pamphlets of Interest to Tool Engineers

WELDING METALLURGY, revised by G. E. Linnert, Armco Steel Corp., 505 pp., indexed, illustrated. Published by the American Welding Society, 33 West 39th St., New York 18, N. Y. Price $2.50.

This second edition of an authoritative handbook, revised by Mr. Linnert, has been brought up-to-date, and includes new information on various processes introduced during recent years. More information is included as well on materials such as the stainless, heat-resisting and stainless-clad steels.

Over 150 pages have been added to the second edition, and a bibliography at the end of each chapter has been included, to suggest additional sources of information on the subject covered in that chapter.

The fundamentals of metallurgy, insofar as needed to thoroughly comprehend the nature of welding and its effects, are covered in the book in simple style which presupposes no previous knowledge of the subject.

THE BASING-POINT SYSTEM, by Dr. Fritz Machlup, The Johns Hopkins University, 275 pp. Published by the Blakiston Co., 1012 Walnut St., Philadelphia 5. Price $5.00.

The first authoritative study of the current basing-point controversy which covers the situation logically is found in this volume. Dr. Machlup discusses the situation in economic terms, pointing out that the system by its nature is both monopolistic and discriminatory.

The history of the development of basing point systems, and their modifications over the years as a result of various court rulings is included, as well as case histories of the basing-point system in three industries: steel, cement and corn products.

BIBLIOGRAPHY ON X-RAY STRESS ANALYSIS, by Herbert R. Isenburger, St. John X-Ray Laboratory, Califon, N. J. Includes 240 references. Price $2.00. Mimeographed.

Material on the X-ray method, and a complete subject index have been added to the bibliography to make it more useful for the laboratory or research worker.

The bibliography includes both American and European works, and is of considerable value in furthering the applications of this work.

PRECISION MEASUREMENT, by Jack Johnson, published by the Pitman Publishing Co., New York; 181 pp. Price $3.00.

This volume is a review of applied mathematics as used in modern methods of inspection and measurement. Including formulas and problems in connection with the mathematical "how-to-do-it" text, the book is of use both in the inspection instances cited and in jobs which are similar in principle.

A review of the elementary principles of trigonometry, squares and square roots leads into the various "projects" of the guide. Each project cites the purpose and application of the problem, lists recommended tools, describes procedure, and follows through with explanation and formula. Drawings are used for clarity. Over fifty of these projects are found, including, for example, the checking of an internal taper; dovetail angles; relief clearance of a die and others.

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MERZ

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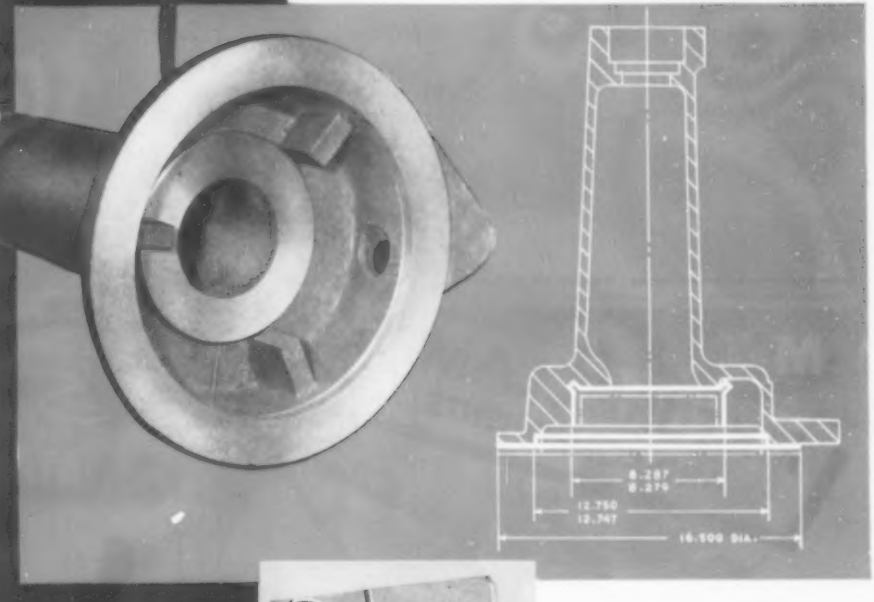
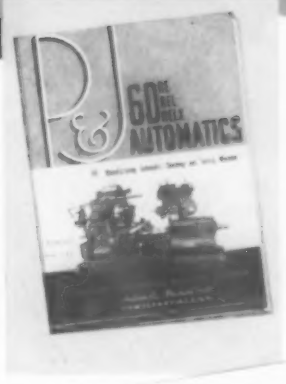


REAR axle housing, that is. Note the size... the 45° angular recess . . . the number of operations (12) for rough and precision-finish boring, spading, chamfering, facing . . .

This class of work is a natural for the P&J Automatic; with this Machine tooled the P&J way, you have a most efficient setup for today's high-speed, close-tolerance requirements. When next you figure on the precision-production of quantity duplicate parts, give consideration to P&J's specialized know-how — and the profitable combination of P&J Tooling on P&J Automatics.



The P&J Tooling, to produce the work illustrated, was set up on the 6DRELX, one of the 6D series of P&J Automatics described in this Bulletin. Write for your copy. It may also pay to get a P&J estimate on your prints or sample parts. Either way, there's no obligation.

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W. M. ZIEGLER TOOL COMPANY
13570 Auburn Detroit 23, Mich.

WRITE FOR CATALOG

Ziegler ROLLER DRIVE FLOATING HOLDER for Taps and Reamers...

OMEGA

makes the CHIPS FLY

...even on tough stainless castings

Ranging up to 3/8-in. thickness, these chips shown in actual size were gouged with relative ease from Type 410 stainless steel castings heat-treated to 250 Brinell. This low-carbon, 12 pct chromium steel is extremely tough, yet there was no apparent injury to the cutting edges of the Omega chisels. The severity of this chipping operation is indicated by the spots of temper colors on the highly-glazed undersurface of the chips. Omega is engineered for just such brutal shock jobs.

Tough is the word for Omega. It thrives on cold-battering jobs where you've got to have a tool steel with super shock-resistance. And Omega has a normal working hardness of 55 to 59 Rockwell C at cutting edges; that's hard enough to *hold* a sharp edge on even the severest kind of shock jobs.

Use Omega for tools like these:

Chipping chisels	Core breakers
Calking tools	Shear blades
Punches	Beading tools
Rivet busters	Swaging dies

Long a toolmakers' favorite for general-purpose shock tools and machinery parts, this fine silico-manganese steel combines ductility, toughness and hardness. There's no better steel for withstanding drastic shocks at normal temperature. It's economical; and it's easy to forge, machine, and heat-treat. Give Omega a trial, as rough as you like. The nearest Bethlehem tool steel distributor stocks it for quick delivery.

THESE PROPERTIES MEAN SHOCK-RESISTANCE

Unnotched Charpy	130 foot pounds
Tensile strength	340,000 psi max
Yield point	280,000 psi max
Hardening, 1625 F, oil quench; 1550 F, water quench	
Tempering	400 to 650 F, Rockwell C 59-55

Analysis	C	Mn	Si	Mo	V
	0.60	0.70	1.85	0.50	0.25

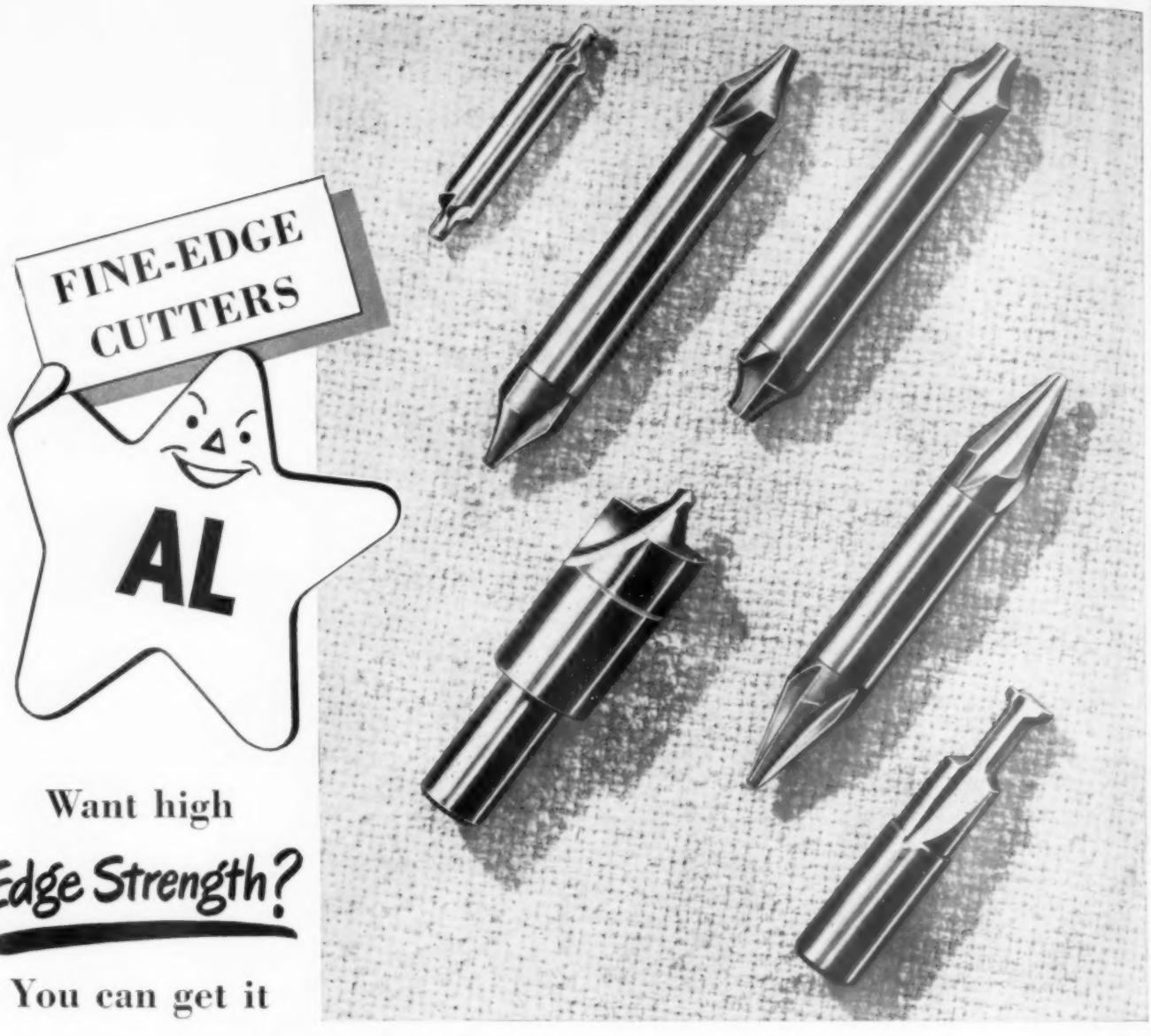
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Export Distributor:
Bethlehem Steel Export Corporation

BETHLEHEM STEEL

OMEGA one of Bethlehem's Fine Tool Steels



Want high

Edge Strength?

You can get it

with DBL-2 HIGH-SPEED STEEL

Write for copy of

"CUTTING TOOL MATERIALS"

Allegheny Ludlum produces *all* types: the various tungsten and "moly" high-speed steels, cast-alloy materials, and cemented carbides. This 36-page booklet analyzes and compares types, and covers grade selection, etc.—invaluable data for production men. *Write for your copy.*

Address Dept. TE-77

A midwestern tool manufacturer, specializing in fine-edge cutting tools, has found DBL-2 *best* for their purpose—added proof of the high edge strength and excellent cutting qualities of this high-speed steel.

DBL-2 (typical analysis: C .80, W 6.00, Mo 5.00, Cr 4.00, V 1.75) represents the 6-6-2 or M-2 type of tungsten-molybdenum high-speed steel. DBL-2 combines high hardness with toughness. Requiring no more than reasonable care in hardening and tempering, you will find it a high-speed steel of great possibilities—capable of giving you performance equal to, or better than, the general-purpose tungsten types, and at reduced cost.

DBL-2 reliability has been proved in a wide variety of cutting tools. Let us help you to use DBL-2 . . . our Mill Service Staff is at your command.

ALLEGHENY LUDLUM
STEEL CORPORATION
Pittsburgh, Pa.

TOOL STEEL DIVISION: DUNKIRK, N. Y.

Fine Tool Steels Since 1854

AL

WAD 2473

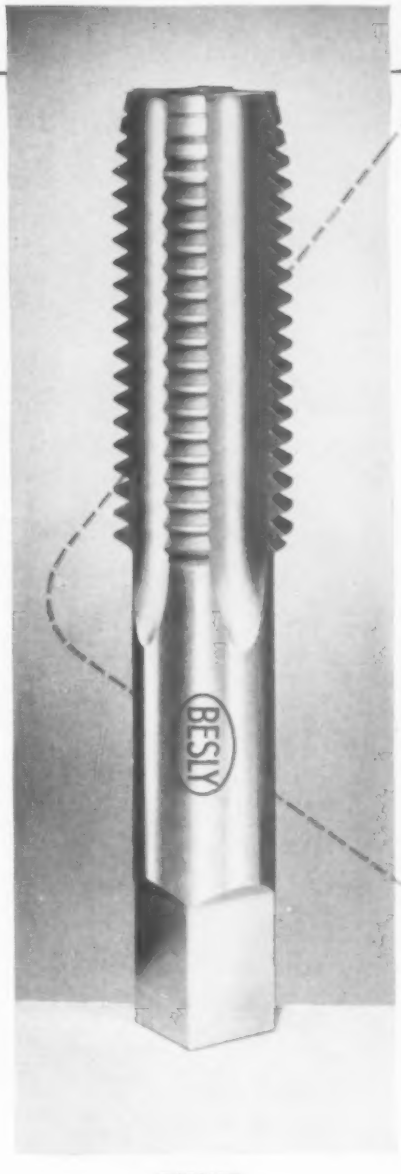
NOW You Can Be Sure of "RIGHT" ROCKWELL

R/C

with the New and Finer

"FORTY-NINER"

BESLY TAPS



Exclusive New Testing Methods Guarantee Correct Hardness for Every Tap

Gone are the days of spoiled holes, ruined and broken taps and costly set-up delays caused by improper tap surface hardening. With Besly "Forty-Niner" Taps *you can be sure* of "right" Rockwell Hardness that assures maximum tap efficiency and maximum tap life.

Every high speed Besly tap produced is individually inspected for correct Rockwell hardness before it is shipped. To our knowledge, no other first rank producer of taps can offer this assurance of protection from taps that "dub over" due to inadequate tempering, or break-off due to excessive hardness.

In the past, it has been virtually impossible to assure *correct* Rockwell in production taps. Now, however, with new and *exclusive* methods and equipment, Besly can—and does—guarantee that:

EVERY tap is accurately tempered to the hardness required to achieve peak performance with the 18-4-1 alloy steel used by Besly for all high speed taps.

Features like this can give you tapped holes at a new low in cost. First rank field engineering service, plus fast handling of your orders may also effect significant savings in today's buyer's market. If you haven't tried Besly Forty-Niner Taps—select a job for trial—you be the judge of their effectiveness. Call your nearest Besly distributor.

BESLY'S "HELPING HAND" HAS 5 STRONG FINGERS

- **Fast Delivery**
  —24 hrs. on high speed specials from hardened blanks;
  —3 weeks on bar stock specials.
- **A Complete Line**
- **Top Tap Quality**
- **Engineering Counsel**
- **Qualified Distributors**

UNSURPASSED ACCURACY at *all* vital points

Microcentric CHAMFER

Micro finish, concentric to tenths of thousandths. Cuts freely and to size without burring or welding.

Solid Ground THREAD FORM

For angle and lead accuracy, elimination of gauging problems and control of pitch diameter to tenths of thousandths. Ground from the solid.

"Right" ROCKWELL

Taps pre-inspected for correct Rockwell hardness.

Mirror Finish FLUTES

Correctly designed to provide freer chip flow and longer tap life.

Tru-Square DRIVER

Square and shank fit correctly in chucks and holders, no wobble to cause oversize holes.

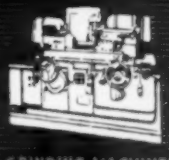
THIS TRADE MARK IDENTIFIES THE WORLD'S MOST ACCURATE TAP

BESLY TAPS • BESLY TITAN ABRASIVE WHEELS
BESLY GRINDERS AND ACCESSORIES

BESLY

CHARLES H. BESLY & COMPANY, 118-124 N. Clinton Street, Chicago 6, Illinois
***Factory:* Beloit, Wisconsin**

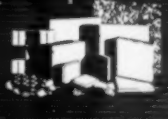
GRINDING WHEELS



GRINDING MACHINES

REFRACTORIES

NORBIDE



NON-SLIP FLOORS

LABELING MACHINES

ABRASIVE PAPER AND CLOTH · · · SHARPENING STONES

AVAILABLE FROM NORTON . . .

the Most Complete Abrasive Service in the World

VARIETY—abrasives for polishing, tumbling and lapping, grinding wheels, segments, bricks and sticks, coated abrasives* and sharpening stones* to meet *all* demands of industry.

DISTRIBUTION—grinding wheel distributor stocks in over 300 cities throughout the world, warehouse stocks in five industrial centers of the United States, factory stocks at the main Worcester plant and at the Norton plants in Canada, England, Australia, France, Germany and Italy.

ENGINEERING—a Norton field staff of abrasive engineers and Norton factory specialists co-operating with over 2,500 distributor representatives the world over.

RESEARCH—a staff of over 135 trained scientists and technicians in well-equipped laboratories—constantly developing new abrasives, new bonds and improved manufacturing processes.

*Products of Behr-Manning Division

NORTON®

NORTON WAREHOUSES

CHICAGO

DETROIT

PITTSBURGH

CLEVELAND

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NORTON COMPANY • WORCESTER 6, MASS.

(Behr-Manning, Troy, N. Y. is a Norton Division)

Layout Man Illustrates Adaptability of Lufkin Inside "Mikes"...

Lufkin tools meet exacting requirements of layout man, John Adams, employed for 14 years at the Mesta Machine Co., Pittsburgh, Pa.

● Every Lufkin Precision Tool has features that are of practical aid to skilled craftsmanship. Lufkin Inside Micrometers measure I.D.'s. from 1½" up. Each rod is marked with its length and rods can be added to either or both ends of the micrometer head.

Tubular, light weight measuring rods can be added to both ends of the micrometer head—thus keeping the head central and in balance—assuring more sensitive "feel" and precise readings.

Ground threads on micrometer heads assure smooth operation and greater accuracy. Rods and caps ground to extremely close limits to permit interchangeability. Heads have "Rapid Reading" (each thousandth numbered) to eliminate errors in reading. Lock nut holds measurement firmly.

Flat surface on knurled collar opposite reading line makes it easy to instantly find reading line even in poor light.

It is easy to adjust micrometer head. Extension rods that show wear are also adjustable by turning hardened and ground plug either into or out of the rod.

Buy

LUFKIN

PRECISION TOOLS
TAPES • RULES
From your distributor

Write Dept. TE for fascinating booklet, "The Amazing Story of Measurement." Enclose 10c (no stamps) to cover handling and mailing.

THE LUFKIN RULE CO.

Saginaw, Michigan • New York City • Windsor, Canada

HOW TO

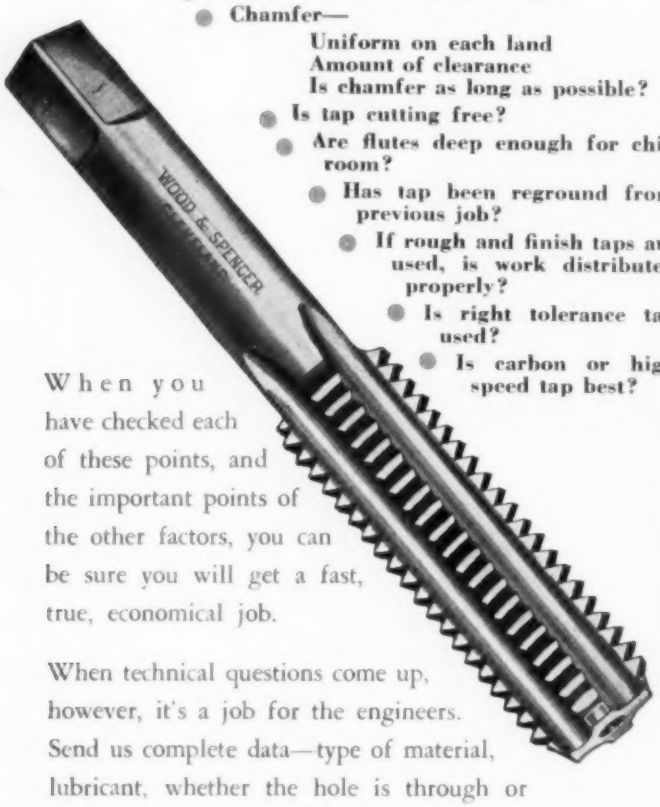
TAPPING TROUBLES

BEFORE THEY START

Tapping is usually a job of coordination. Four different factors—material being tapped, machine and fixtures, lubrication and the tap itself control the quality, speed and economy of the job. Checking each point on all the major factors, *before the job starts* is the surest way to avoid tapping troubles. On the tap itself, be sure to check these points:

CHECK TAPS FOR:

- **Proper style being used?**
- **Proper amount of hook or rake?**
- **Chamfer—**
  - **Uniform on each land**
  - **Amount of clearance**
  - **Is chamfer as long as possible?**
- **Is tap cutting free?**
- **Are flutes deep enough for chip room?**
- **Has tap been reground from previous job?**
- **If rough and finish taps are used, is work distributed properly?**
- **Is right tolerance tap used?**
- **Is carbon or high speed tap best?**



When you have checked each of these points, and the important points of the other factors, you can be sure you will get a fast, true, economical job.

When technical questions come up, however, it's a job for the engineers. Send us complete data—type of material, lubricant, whether the hole is through or blind and any other pertinent information. Our engineers will be glad to make definite suggestions without obligation.

The Wood & Spencer Company
Cleveland 3, Ohio

DRILL HARDENED STEEL WITH "HI-ROCK-WELL" DRILLS WITHOUT ANNEALING

Every toolroom needs Ray-Metal "Hi-Rockwell" drills. These tools drill precision holes in steels testing C-40 to C-68 Rockwell quickly and without annealing. Ideal for reworking tools and dies, they actually cut a curled chip! *THEY CUT!!!*

Sales territories open.

Available in standard sizes—order from:

RAY-METAL
RIGID-CARBIDE-TOOLS

9500 Carbon Street — Detroit 17, Michigan

have we your right address?

if you've moved, notify ASTE headquarters of your new address so that THE TOOL ENGINEER and other society information will reach you promptly. Write your NEW and OLD address on a penny postcard and mail to:

American Society of Tool Engineers
10700 Puritan Ave., Detroit 21, Michigan

Columbia TOOL STEEL

CLARITE—
Standard 18-4-1 High Speed Steel

Today's CLARITE is at its all time quality peak. Full alloy content, close chemical and metallurgical tolerances.

An outstanding "good" tool steel

COLUMBIA TOOL STEEL COMPANY
ARTHUR T. CLARAGE, PRESIDENT
MAIN OFFICE AND WORKS
520 EAST 14TH. STREET • CHICAGO HEIGHTS, ILL.

UNIVERSAL

marches at the head of the drill bushing parade!

super finish reduces wear to a minimum

blended radius banishes tool hang-up

100% hardness and concentricity tests assure accuracy

knurled head provides quick sure grip

ample stocks in 3 warehouses assure immediate delivery

The main office at Frankenmuth, Michigan, and Universal warehouses at 89 Main St., Ansonia, Conn., and 5035 Sixth Ave., Kenosha, Wisc., offer prompt delivery.

UNIVERSAL ENGINEERING COMPANY
FRANKENMUTH 3, MICHIGAN

OTHER UNIVERSAL PRODUCTION TOOLS

BORING CHUCK

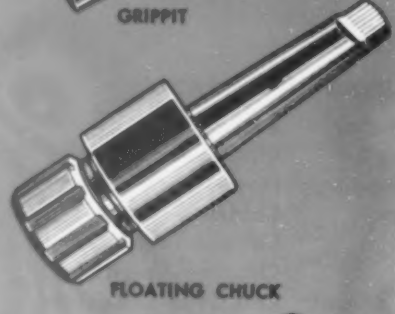
MIKRO-LOK BORING BAR

INDEX PLUNGER

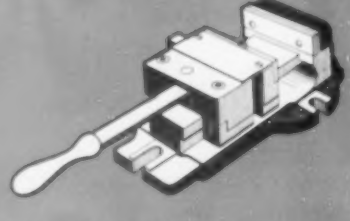
STANDARD DRILL BUSHING

STANDARD COLLET CHUCK

GRIPPIT



FLOATING CHUCK



WEDGE-LOCK PRODUCTION VISE

Facilities Available for Special Hardened and Ground Precision Parts Made to Customer Specifications

"Part of the picture" in
Vanadium-Alloys **TOOL STEEL** specialization

First quality

COLD DRAWN TOOL STEE

DRILL ROD GRADES

ıld Anchor	Red Anchor
ısco M-2	Blue Anchor
ısco Supreme	Non-Shrinkable
ın-Lom	Colonial No. 6
N-2	Carbon-Vanadium
V. M.	Chrome-Vanadium
d Cut Cobalt	Red Star Tungsten
eatro	Hotform

Standard Shapes

uares · Flats · Hexagons · Octagons

Special Shapes

See our Bulletins for typical examples

produced by our **Anchor Drawn Steel Divisio**

for toolmakers everywhere . . .

Anchor Drawn Steel Company's job in the Vanadium-Alloys family is the cold finishing (drawing, grinding, etc.) of the High Speed, Alloy, Carbon and Special analysis Tool Steels produced by our Vanadium and Colonial Steel Divisions. You may be sure that Anchor's many years of concentration upon *perfection in production* guards our steel quality in every grade, in every cold drawn size and shape that saves you money . . . that delivers better *performance* at the working point. Our representatives will help you select the proper cold finished steel for your job or help you work out special shapes to save you machining costs.

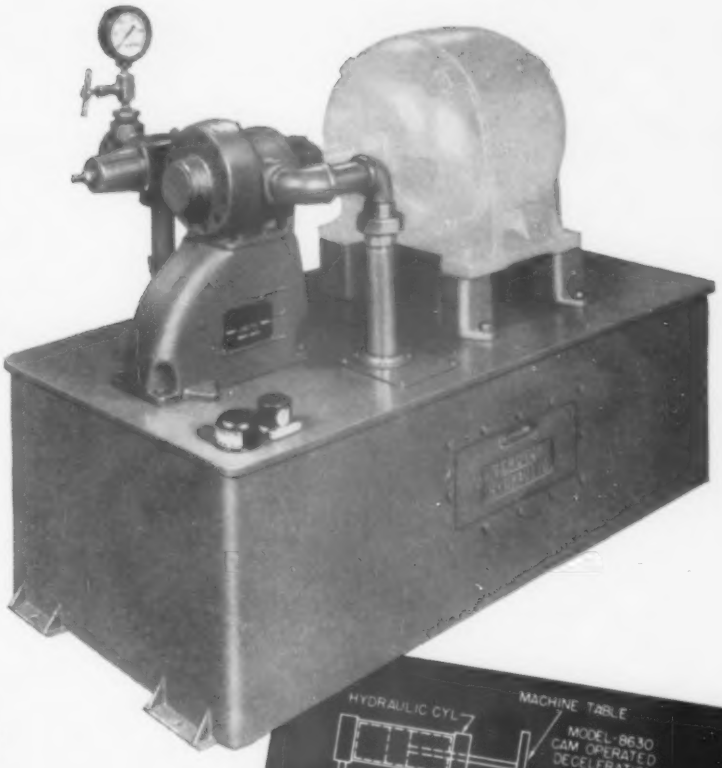
Manufacturers of
FIRST QUALITY
TOOL and DIE STEELS
— exclusively

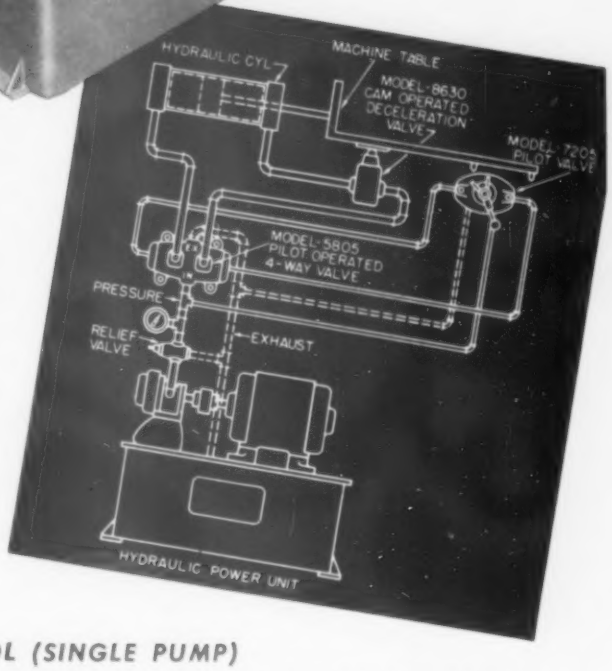
Vanadium-Alloys
STEEL COMPANY
COLONIAL STEEL DIVISION ANCHOR DRAWN STEEL CO.
LATROBE, PENNA.

YOU GET A

Complete Package

-with a GEROTOR POWER UNIT

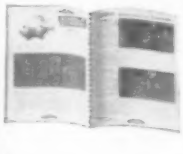




Gerotor offers the Series 9100 Pump Unit as the ideal source of power for your hydraulic circuit. In addition to the highly efficient Gerotor pump, the unit is equipped with relief valve, oil filter, pressure gauge, and all equipment to furnish a steady flow of oil at continuous working pressures up to 1000 P.S.I. Reservoir is available in 5 tank sizes, with pump capacities from .4 G.P.M. to 40 G.P.M. Motor mounting may be arranged for any standard frame. Gerotor double pumps are supplied for installations of two separate circuits.

REMOTE PILOT OPERATED CONTROL (SINGLE PUMP)

Starting the electric motor results in the continuous reciprocating of the cylinder rod. In one position of the Model 5805 Pilot operated 4-Way valve, oil is directed from the pump to the blind end of the hydraulic cylinder, causing the cylinder to extend at its rated speed. When the machine table advances to where it depresses the cam of Model 8630 flow control valve, the forward speed of the cylinder is affected by the setting of the flow adjusting screw of Model 8630 valve. In the other position of Model 5805 valve, oil is directed from the pump to the rod end of the hydraulic cylinder causing it to retract at full rated speed. In this direction of cylinder movement, Model 8630 has no effect on the speed of the cylinder. Model 7205 Pilot valve provides for remote hydraulic operation of the main 4-Way valve, Model 5805. The forward, or return stroke of the cylinder may be manually interrupted at any time by reversing the handle of the Model 7205 Pilot valve.

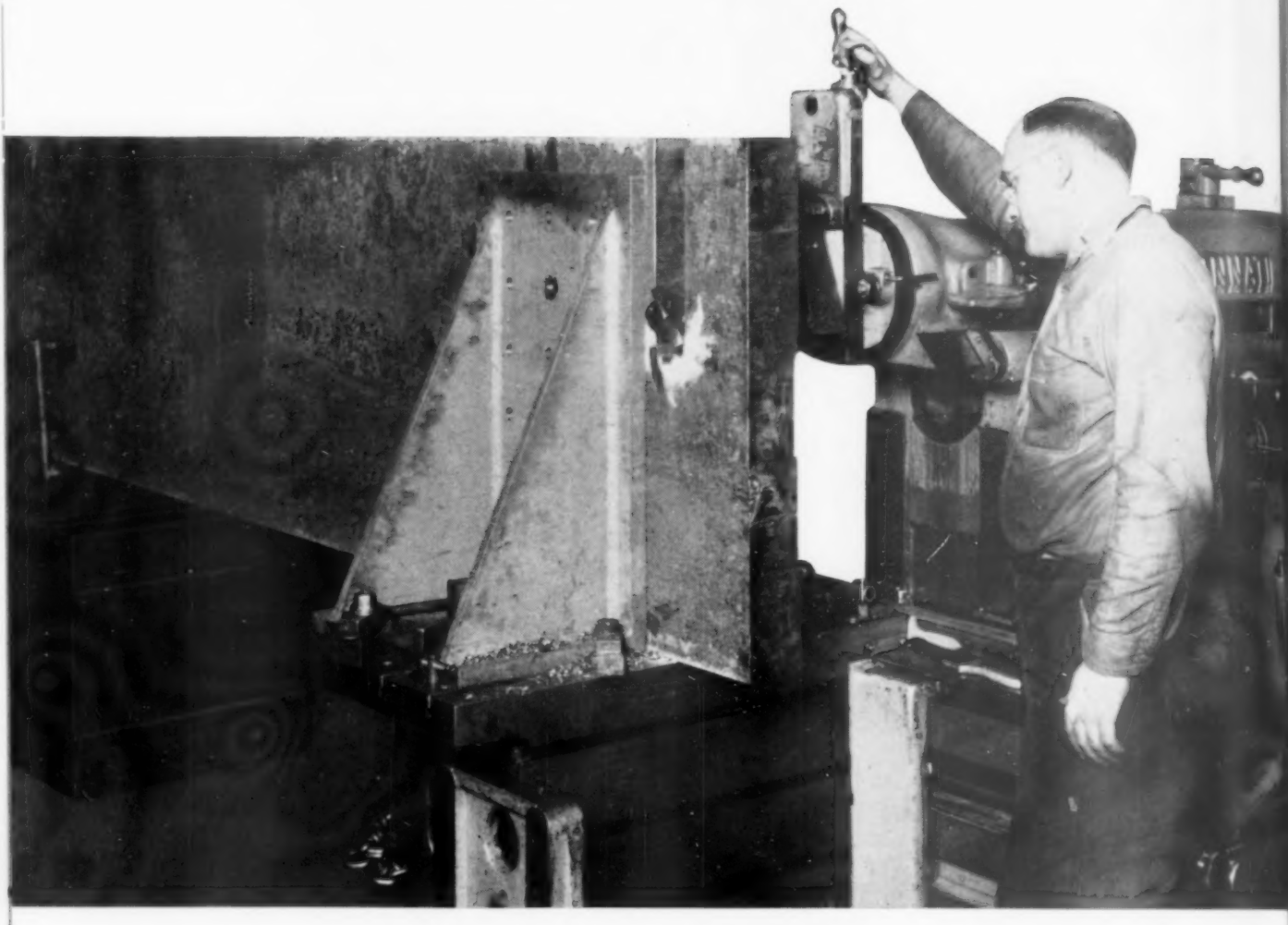


Write for Catalog Section G-105 showing specifications and description of Gerotor Hydraulic Pump Units.

GEROTOR MAY CORPORATION • Dept. TE-7 Baltimore 3, Md.

WHEN YOU APPLY HYDRAULIC OR AIR POWER *Plan with* **GEROTOR**

AIR AND HYDRAULIC VALVES AND CYLINDERS, HYDRAULIC PUMPS, MOTORS AND PUMP UNITS



Shaping a BIG job...

Internal shaping bearing seats in this 5500-lb. steel plate to a tolerance of .001 indicates the accuracy and rigidity of Cincinnati Shapers.

The rapid and accurate metal removal, and the low-cost setup for shaping this 12′ steel plate on the sturdy Cincinnati table, give low-cost operation.

The unusual flexibility of change from job to job in minimum time and with minimum costs of tooling and fixtures also has made the Cincinnati Shaper the handy man of industry.

A versatile Cincinnati Shaper will be a busy and profitable machine in your shop.

Write for Catalog N-5 for detailed description of the types and sizes of Cincinnati Shapers.

THE CINCINNATI SHAPER CO

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

For Lower Production Costs

Power Feed BY AIR

WHEN you're figuring ways to reduce production costs — here's something to think about:

> *In such operations as drilling, tapping, reaming, milling, etc., you can cut costs 15% to 60% by replacing manual feeding with Bellows "Controlled-Air-Power" feeding.*

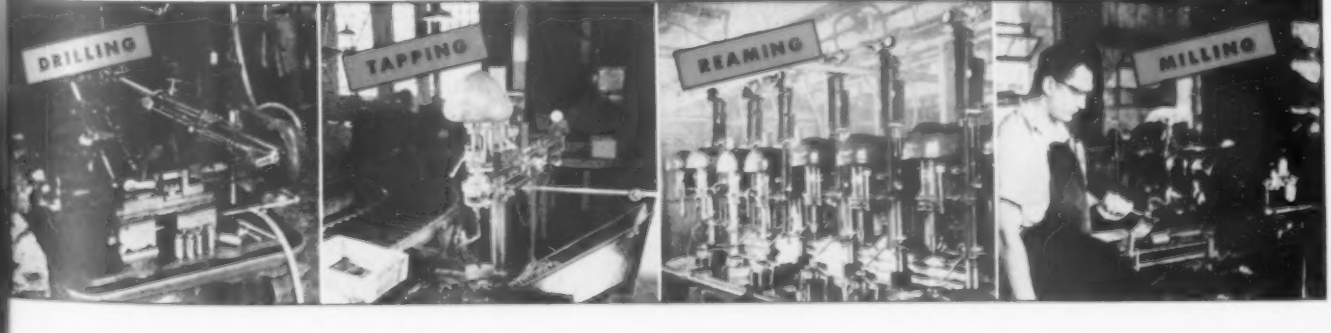
These inexpensive power feeding devices are easily installed on almost any standard machine tool. Precision controls provide correct feeding rates for any tool or material . . . cut down rejects . . . assure more uniform production. With Bellows "Controlled-Air-Power" Feeds one operator is often easily able to run two or more machines with no more effort than he formerly spent on one — and with unit cost savings of 50% or more.

WRITE FOR THIS FREE BOOKLET

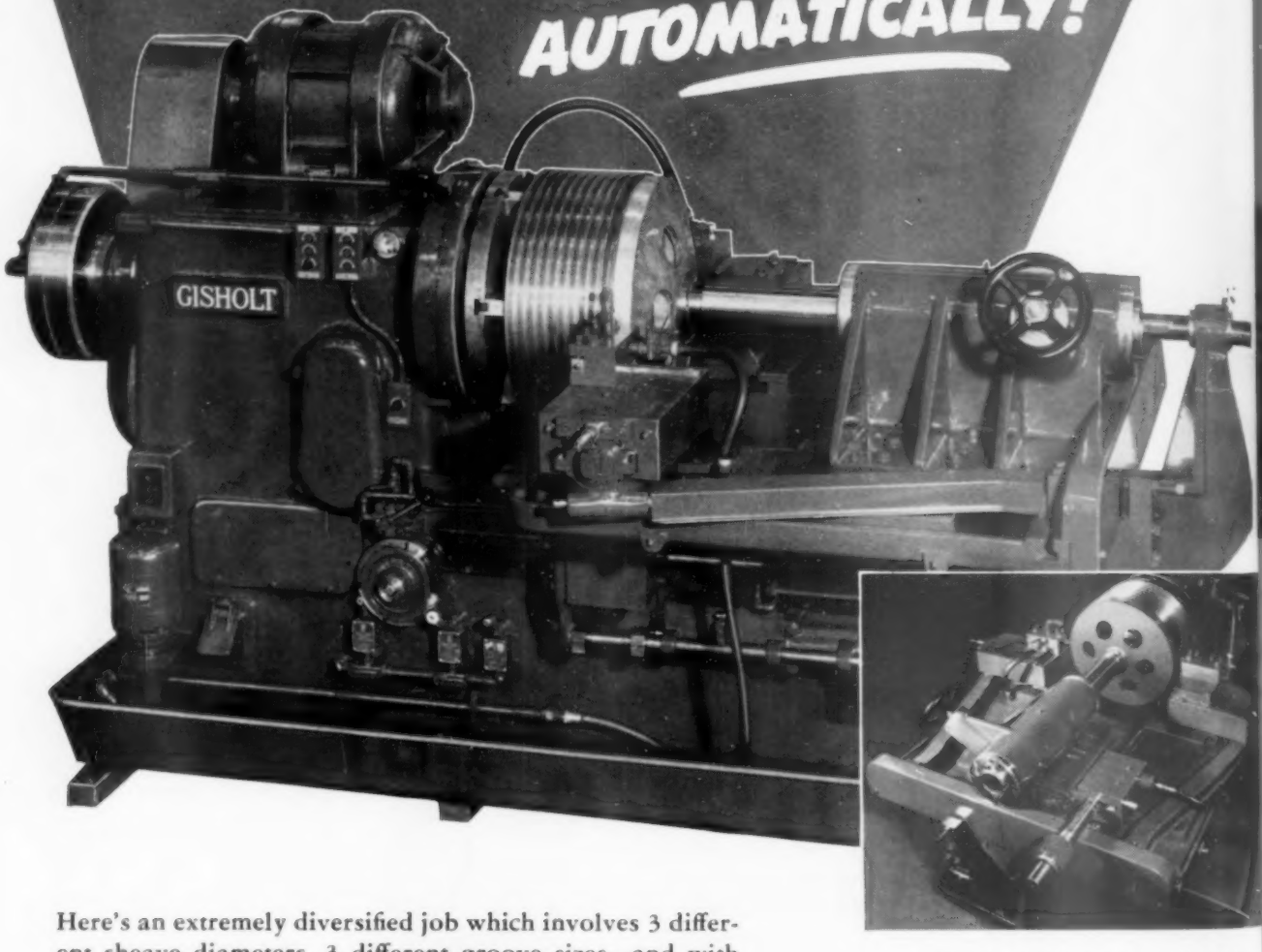
See how alert production men in all industries are cutting costs with "Controlled-Air-Power." No cost — no obligation but to read it carefully. It will help you save time and money. Address The Bellows Co., Dept. AM-649, Akron 9, Ohio.

The Bellows Co.

AKRON, OHIO



How the SIMPLIMATIC machines 212 different multiple V-belt sheaves AUTOMATICALLY!



Automatic pawl fitting into notched bar sets groove position. A single tool bit on the front slide roughs, while the tool bit on the rear slide finish forms. At end of cut, table is automatically repositioned for next groove. Spindle stops and table retracts automatically at end of job.

Here's an extremely diversified job which involves 3 different sheave diameters, 3 different groove sizes—and with from 3 to 10 grooves on each sheave . . . a total of 212 different combinations! Yet the entire job is simplified to *one* machine—the Gisholt SIMPLIMATIC. The SIMPLIMATIC handles them all automatically—with various pick-off gears and face clamps. The grooves are machined progressively one at a time to avoid excessive heat and strains in the workpiece. Total machining time ranges from 2.7 minutes for the smallest to 11.5 minutes for the largest.

It's one more example of the amazing versatility of this automatic machine. Investigate the SIMPLIMATIC before you invest in a special machine.

GISHOLT

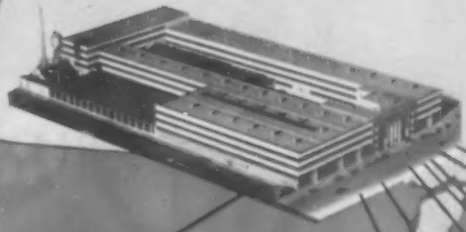
THE GISHOLT ROUND TABLE *represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.*

GISHOLT MACHINE COMPANY

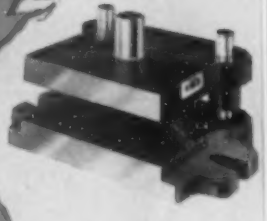
Madison 10, Wisconsin

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINE

Why You Get FASTER SERVICE from DANLY



BRANCH ASSEMBLY PLANTS IN 8 KEY AREAS



Any Standard Die Set Is Available at Your Nearest Branch Assembly Plant.

Complete stocks of all types and sizes of Danly Die Sets are carried in Danly's eight branch-plants.

Call on the Danly Branch Nearest You.

Chicago 50, 2100 South 52nd Avenue
Cleveland 14, 1550 East 33rd Street
Dayton 2, 990 East Monument Avenue
Detroit 16, 1549 Temple Avenue
Grand Rapids, 113 Michigan Street, N. W.
Long Island City 1, 47-28 37th Street
Los Angeles 54, Ducommun Metals & Supply Co., 4890 South Alameda
Rochester 4, 16 Commercial Street
Milwaukee 2, 111 East Wisconsin Avenue
Philadelphia 44, 18 West Chelten Avenue

Write for *free* bulletin

This bulletin contains helpful information and shows how you can use Danly's machining service for "extra" operations on your die set that will save you time and money in the long run.

TAKE ADVANTAGE of Danly's faster service. The die set you order is immediately assembled at a nearby Danly Branch Plant from complete stocks on hand. Save time—simply consult our catalog and place your order with the nearest Danly Branch. Shipment will be prompt.

Precision manufacture at Danly's main plant permits complete interchangeability of die set components. These parts, stocked at each branch, can be assembled into the thousands of possible combinations listed in the Danly catalog. Located in principal die making centers, each Danly branch can make any standard die set immediately available to you.

For prompt service on your next die set order, write, phone or wire "Danly."

NOW—Steel Plate in Stock

Steel stores of plate 1" to 8½" thick permit immediate manufacture of any size special all-steel die set or bolster plate made to your specification.

DANLY MACHINE SPECIALTIES, INC.
2100 SOUTH 52ND AVENUE, CHICAGO 50, ILLINOIS

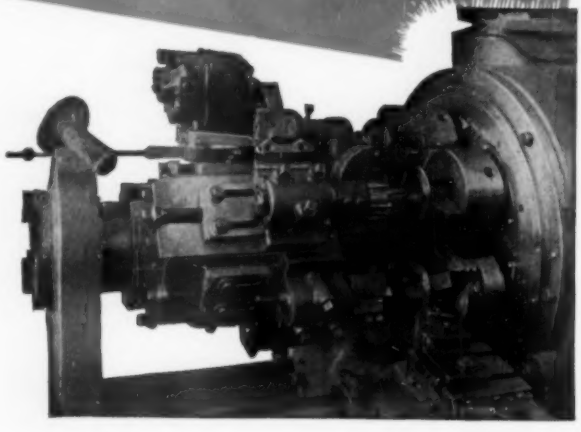
DANLY

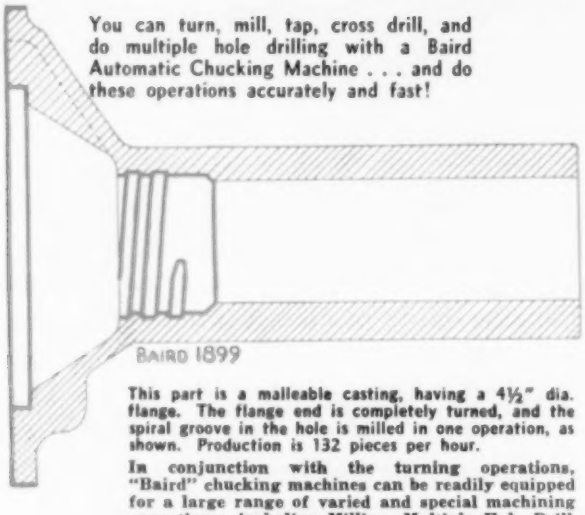
25 YEARS OF DEPENDABLE SERVICE TO THE STAMPING INDUSTRY

PRECISION DIE SETS . . . STANDARD AND SPECIAL

versatility

COMPLETE TURNING PLUS MILLING OPERATIONS ARE READILY ACCOMPLISHED ON BAIRD AUTOMATIC CHUCKING MACHINES





You can turn, mill, tap, cross drill, and do multiple hole drilling with a Baird Automatic Chucking Machine . . . and do these operations accurately and fast!

This part is a malleable casting, having a 4½" dia. flange. The flange end is completely turned, and the spiral groove in the hole is milled in one operation, as shown. Production is 132 pieces per hour.

In conjunction with the turning operations, "Baird" chucking machines can be readily equipped for a large range of varied and special machining operations: including Milling, Multiple Hole Drilling, Tapping, Cross Drilling, etc.

When you have turning operations that must be done profitably:

ASK BAIRD ABOUT IT

Write us for complete specifications of the many Baird Automatic Chucking Machines.

THE BAIRD MACHINE COMPANY
STRATFORD, CONNECTICUT

Acme Offers Complete Facilities for

PRECISION GRINDING

FAST SERVICE... LOW COST

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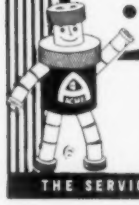

Acme is equipped to handle all types of precision grinding. Expert craftsmen, using newest methods and modern equipment, will do the job for you faster, better, more economically. Acme also offers a flat lapping service that can finish surfaces to within millionths. Write for details.

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Makers of Standardized Jig & Fixture Bushings
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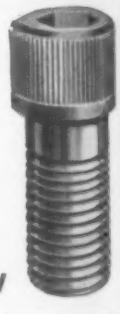

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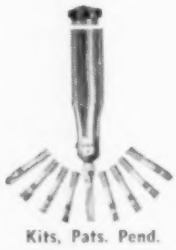
Reg. U. S. Pat. Off.

KNURLED SOCKET HEAD CAP SCREW

Yes, the "UNBRAKO" Knurled Socket Head Cap Screws are real time-savers, because, the knurled head provides a "sure grip" even for oily, greasy fingers; therefore, the "UNBRAKO" can be screwed-in faster and farther before it becomes necessary to use a wrench. And, carefully controlled processing during manufacture assures Strength and Accuracy.



Kits, Pats. Pend.

Knurling of Socket Screws originated with "Unbrako" in 1934.

"Hallowell" Key Kit

You can't tighten or loosen socket screws without a hex socket wrench, so why not get our No. 25 and No. 50 "HALLOWELL" Hollow Handle Key Kit which contains almost all hex bits.

Write for the name and address of your nearest "UNBRAKO" Industrial Distributor and your copy of the "UNBRAKO" Catalog.

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Be Sure
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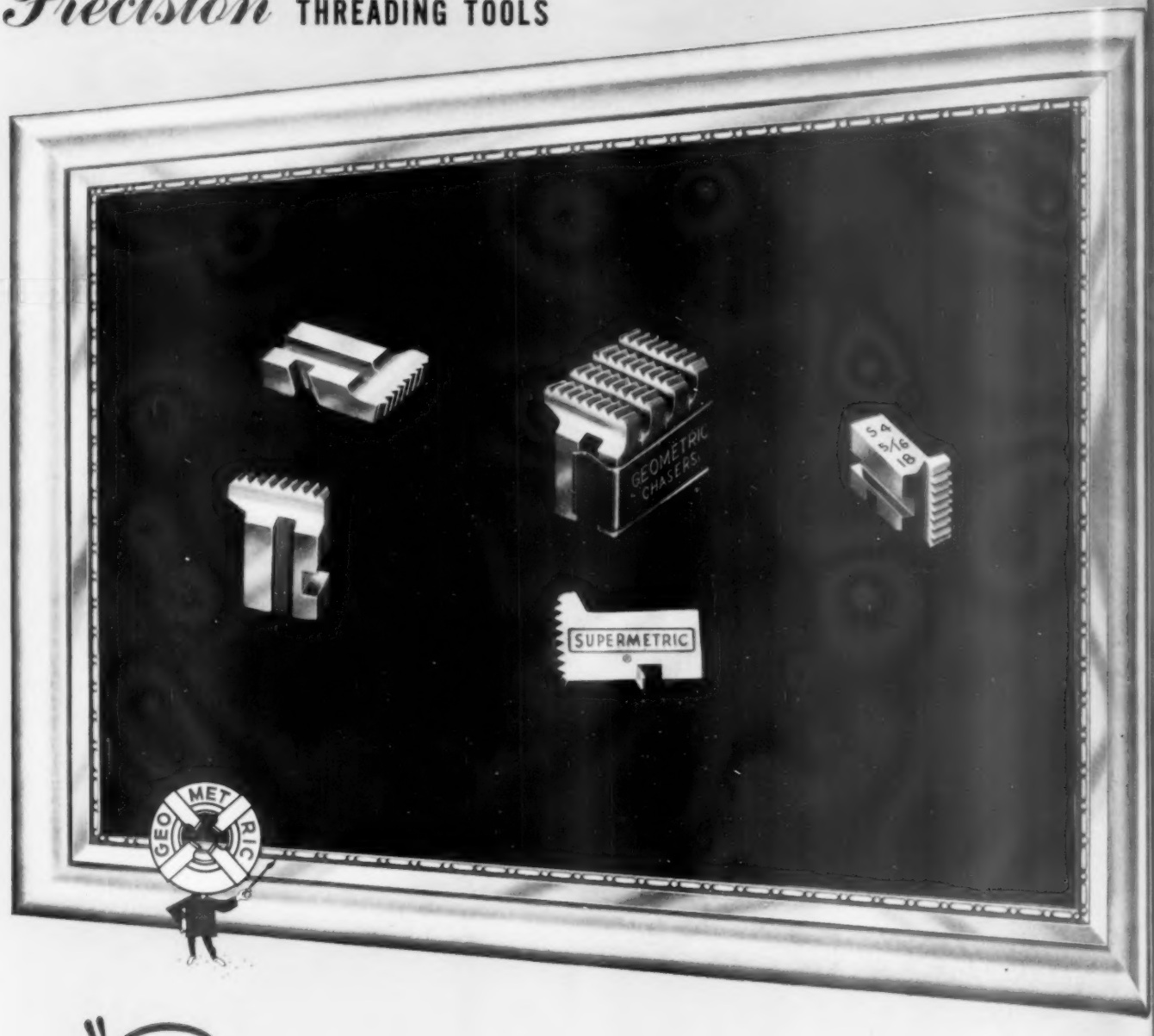
Precision THREADING TOOLS



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Newest development in chasers, with the threads, keyways, cam lug slots and other surfaces finished to a high degree of precision and smoothness.

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NOW . . . Available for $\frac{9}{16}$" Styles D, DS and DJ . . . in addition to $\frac{5}{16}$" Styles DS and DJ Geometric Die Heads.

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GEOMETRIC also makes a complete line of Rotary and Stationary Self Opening . . . and Solid Adjustable Die Heads—Collapsing . . . and Solid Adjustable Taps—and GEOMETRIC Chasers.

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ADVANTAGES of this new abrasive belt method:

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All this and CONTOURS too!

BEHR-MANNING APPLICATION ENGINEERS have developed a method using coated abrasive belts which on the most difficult of contours produces uniformly superior finishes—free of wheel marks—free of blending marks—and does it quicker and easier. The "know-how" on this new profitable method is yours for the asking, with no obligation. Simply fill out the coupon below and mail it to us.

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NORTON *abrasives*

I want to know more about contour polishing with abrasive belts.

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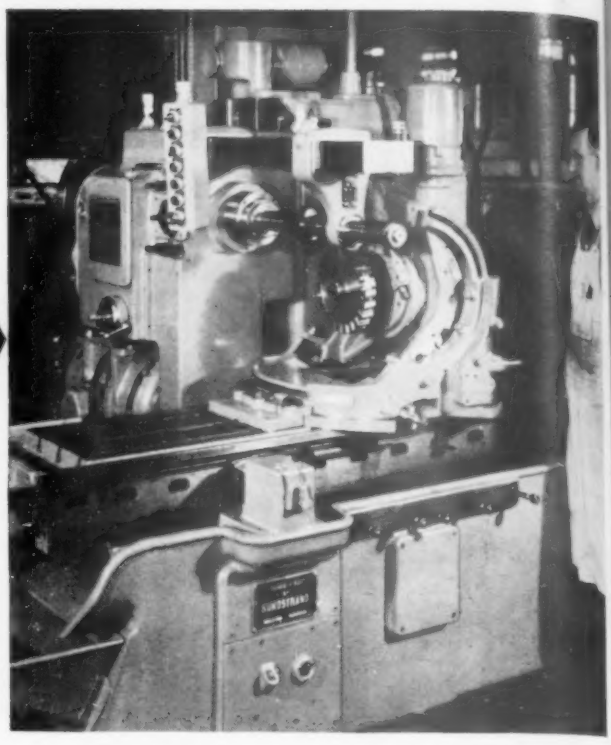
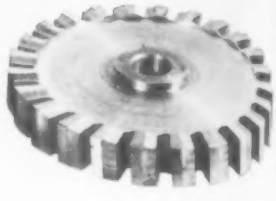
YOU'LL GET PRACTICAL MILLING METHODS LIKE THESE WITH SUNDSTRAND "ENGINEERED PRODUCTION"



Basically, there are two approaches to solving milling production problems, (1) obtaining standard machines, then trying to process parts over these machines as economically as possible, (2) designing the most profitable processing method, then obtaining machines to suit this method — standard or semi-standard machines, if possible, or entirely special machinery, if necessary.

The latter method is Sundstrand "Engineered Production" . . . the most practical approach to economical milling. The following is a brief resume of the complete engineering and manufacturing service available from Sundstrand to meet any of your production milling requirements.

These actual examples are presented to reveal one of each of the methods used in solving milling production problems. One of these methods may be the solution to your present problem.

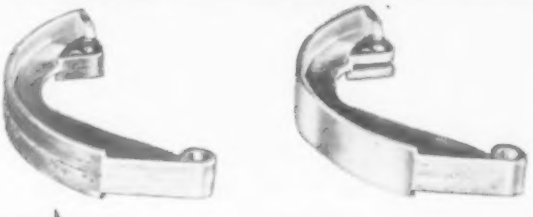


1 Milling Blade Slots and Chip Clearance in Cutter Bodies with a Standard Rigidmil

Here's a practical solution to milling a large number of different size parts requiring similar operations. These milling cutter bodies come in small lot sizes from one to eight. They require milling cuts on both the face and O.D. The machine used is a standard Sundstrand Model 33 Rigidmil with a power operated elevating attachment for positioning the head. A universal automatic index fixture was provided in order to handle the wide range of cutter body sizes. This index unit handles automatic spacing from 2 to 40 spaces . . . can be adjusted vertically thru 110° (from 10° below horizontal to 10° past vertical) and thru 90° horizontally (45° each side of the centerline of the table). Compared to the former method, this Sundstrand equipment reduced the machining and set-up time for these operations from 19.2 to 10.4 hours on a total of 30 parts of 8 different sizes.

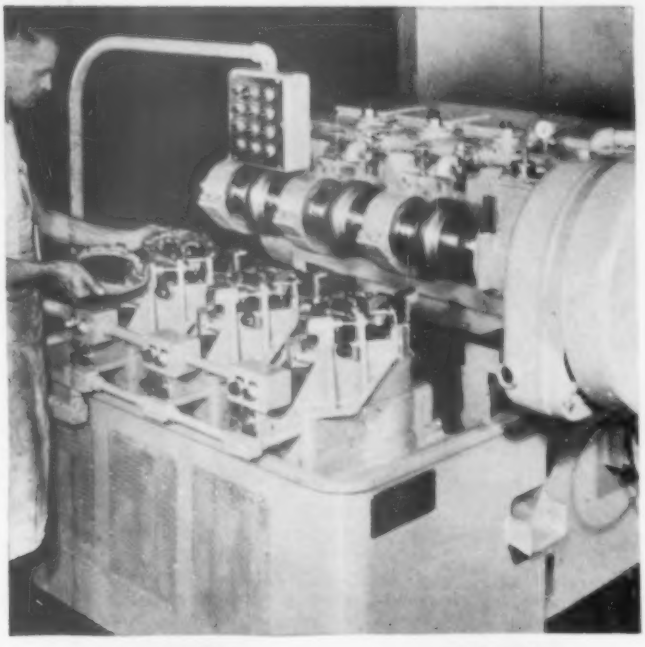
SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS U.S.A.

RIGIDMILS • FLUID-SCREW RIGIDMILS • AUTOMATIC LATHES • HYDRAULIC EQUIPMENT



2 Standard Rigidmil with Special Head Mills 145 Brake Shoes Per Hour

This Sundstrand Rigidmil is provided with a special high speed head equipped with one vertical and one horizontal spindle. Each spindle has endwise adjustment, and the horizontal spindle is provided with automatic retraction. Two power operated rotary tables are timed and interlocked with the automatic table cycle for rotary milling of the face and slot in washing machine brake shoes. Manually clamped fixtures hold the part for a cycle of load and unload at one end while milling at opposite end. Production is approximately 145 per hour.

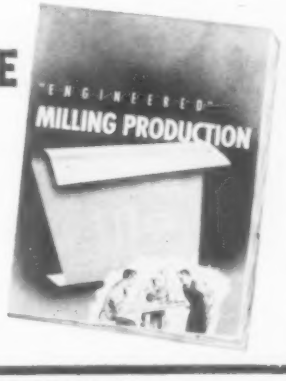


3 Special Rigidmil Mills Over 250 Clutch Plates Per Hour

This special traveling head Sundstrand Rigidmil mills the top and both sides of three lugs on various sizes of clutch plates at a rate of one completed part per machine cycle. The machine operates in an automatic cycle started by push button. It has three work-holding stations each with a three position automatic index fixture. At the end of each cycle of the head, the work part at one station is automatically unclamped, manually unloaded and loaded, and automatically clamped. One part is completed with each cycle, and production obtained is approximately 250 pieces per hour.

More Proof...FREE

Write for more proof of the successful application of Sundstrand "Engineered" milling production. This 40 page book contains over 35 actual problem solutions together with interesting tooling diagrams. Write for your copy today. Ask for Bulletin No. 785.



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Protectron *prevents* costly tool and die breakage. Senses oversized or overhard stock, "pile-ups", and tool dullness. Automatically trips the machine at the slightest *mechanical* overload from whatever cause before damage occurs. Further: Protectron cuts costly down time and lengthens tool life up to 300%. New Protectron model covering all loads is now ready for delivery.

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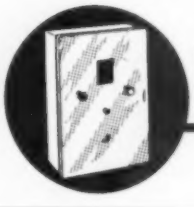

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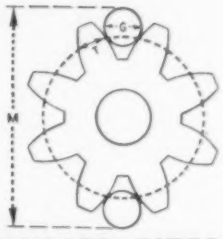
simplified GEAR MEASURING SYSTEM



is the most accurate and economical method of measuring tooth thickness of external and internal spur gears, helical gears and involute splines.

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STANDARD SIZES OF WIRES ARE AVAILABLE FROM STOCK

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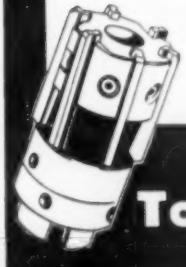

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Sizes 1" and larger stocked also threaded for shanks — tapered or straight — in various sizes.

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Standard and Heavy Duty Types 8 sizes each. Made also for shaped cavities — as ordered.

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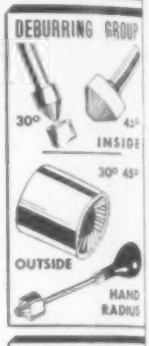

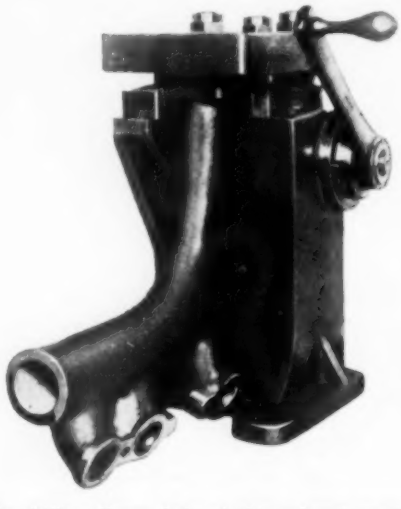

In drilling flange hole of this exhaust manifold a special base was provided on account of its height. However a Swartz L type fixture is plainly recognized.

Reduce Clamping Time of Odd Shape Parts

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One Wrench Often Replaces Four Slow Operating Clamps

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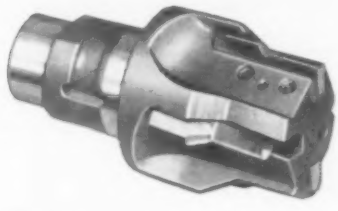

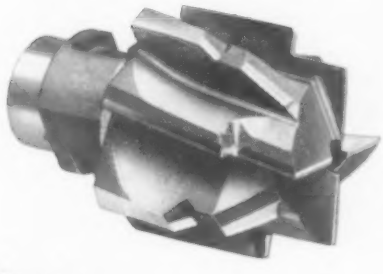

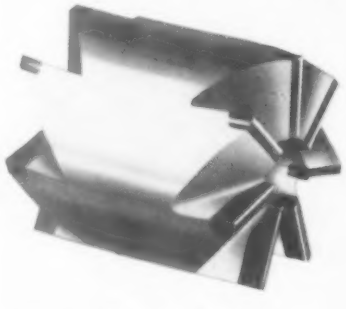

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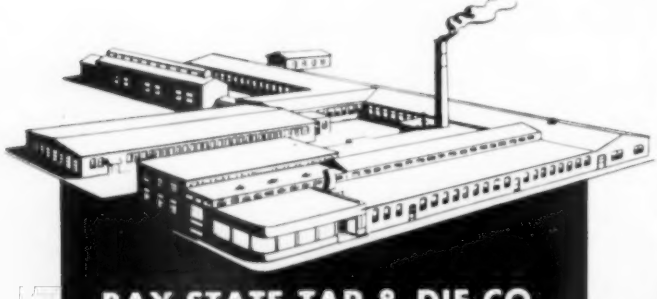

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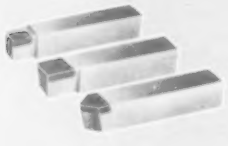

CUTTING TOOLS

DRILL JIG BUSHINGS

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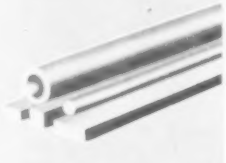

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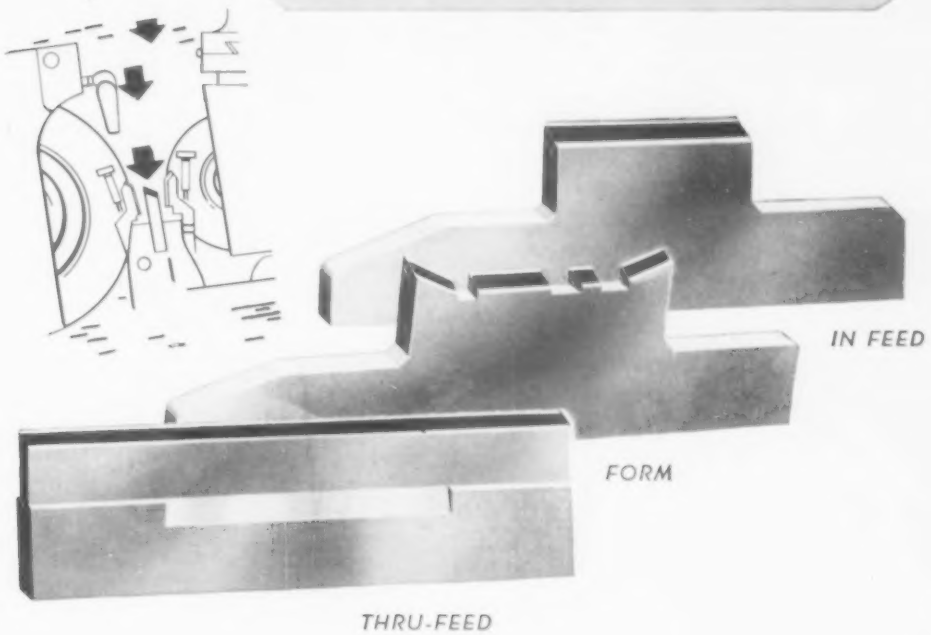

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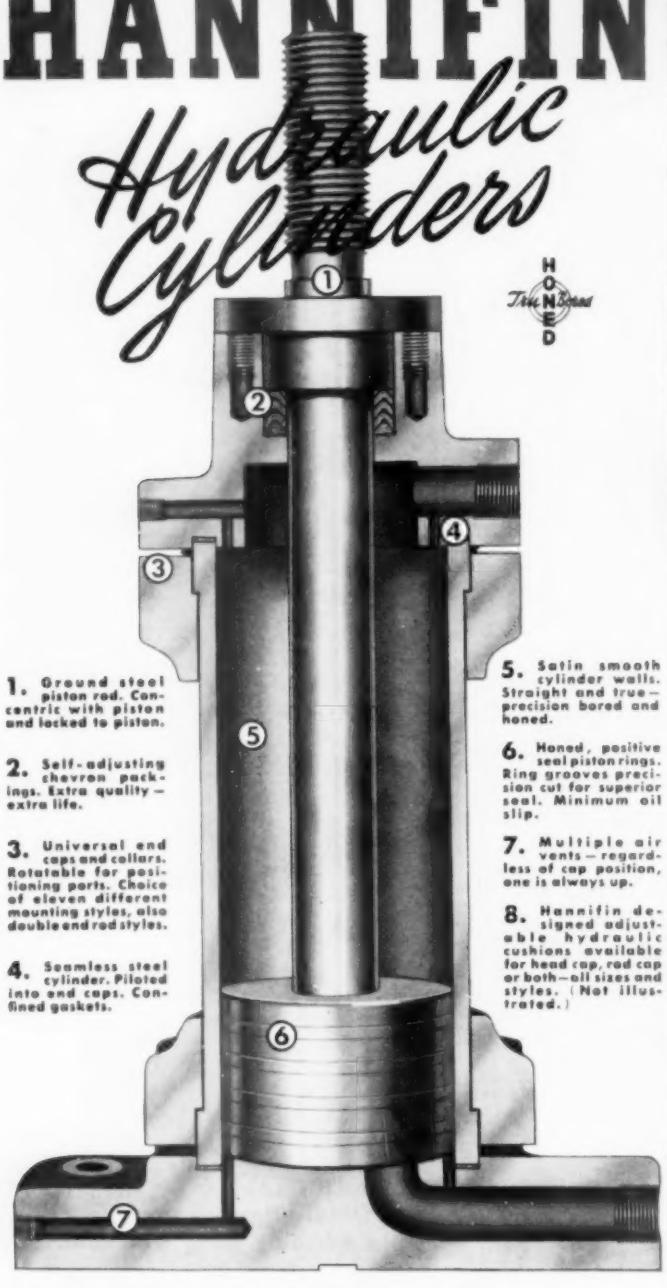

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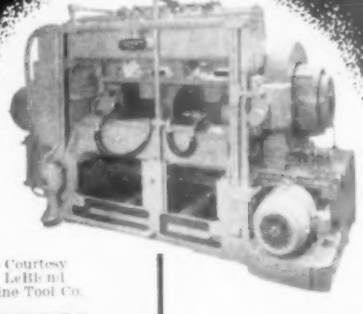

Photo Courtesy R. K. LeBlond Machine Tool Co.

Illustrated is a LeBlond 4 Station Indexing Drum Machine for Turning Automotive Crankshafts, equipped with a ½ H.P. Model 11023-B Long Ruthman Gusher Pump.

Expertly designed and precision built of the best materials, Ruthman Gusher Coolant Pumps give you top performance on your coolant systems. Their wide acceptance as the leaders in the coolant pump field is your best assurance that Ruthman Gusher Coolant Pumps are the best you can buy. If you want more for your money, specify Ruthman Gusher Coolant pumps on your machines today.

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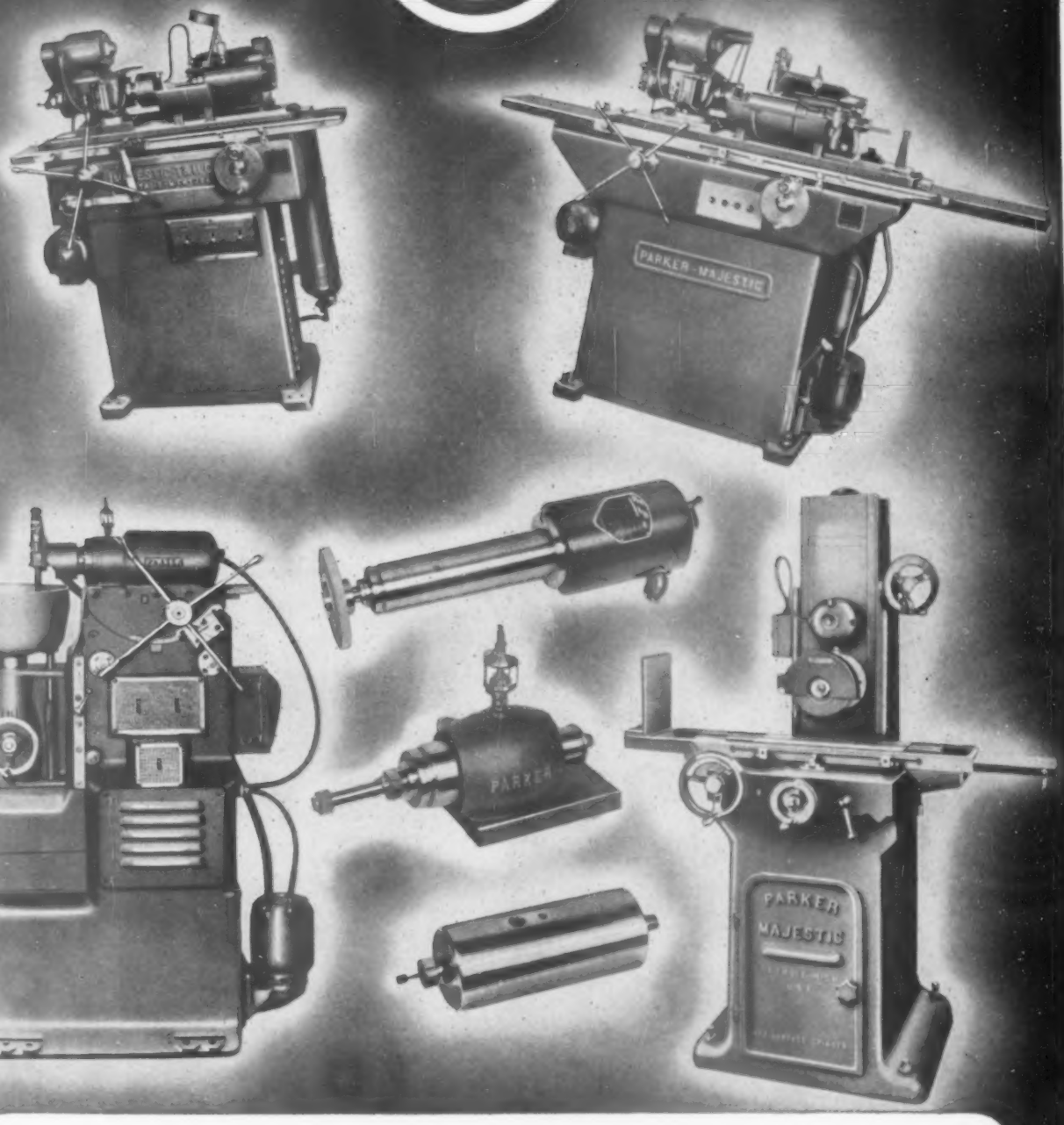

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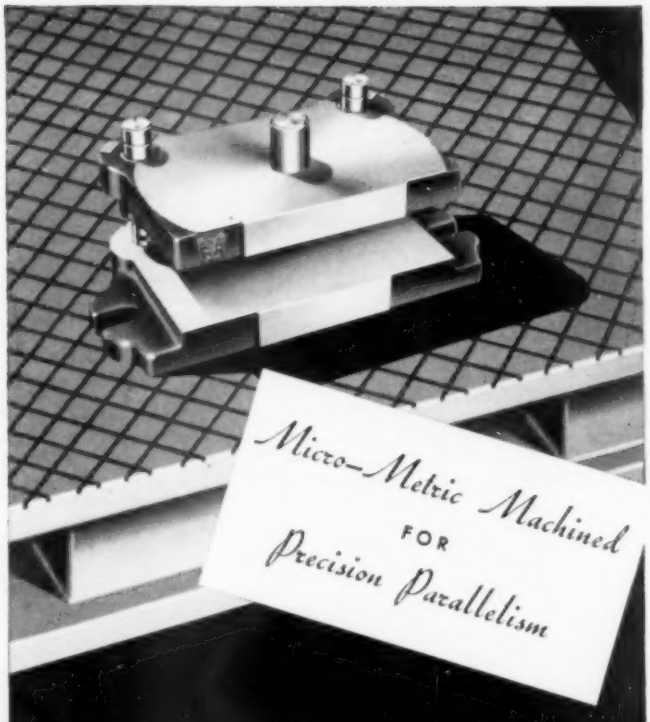

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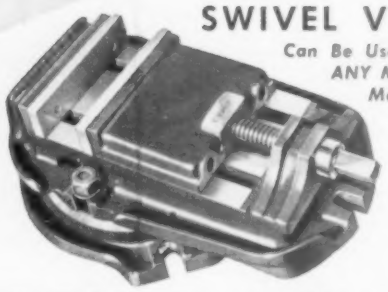

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THE ENGINEERED *American* WAY

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The operation sequence is as follows:

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Fifty-three (53) Xmas Tree Shapes are broached $\frac{1}{2}$" deep through $1\frac{5}{8}$" length of cut on a $11\frac{3}{4}$" diameter wheel.

American Engineering is available for all turbine Broaching problems.

Engineered Broaching by American has proven time and again the way to economy and high production on a multitude of metal cutting operations. An engineered combination of American Broaching Machines, fixtures, and broaches is the efficient answer to production questions. Why not ask your question? Send a sample part, or blueprint, plus hourly requirements. We'll be glad to make recommendations. Request your copy of Circular Number 300. Address Department T.

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A DIVISION OF SUNDSTRAND MACHINE TOOL CO.

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See *American* First — for the Best in Broaching Tools, Broaching Machines, Special Machinery

Index of Tool Engineer Advertisers

JULY, 1949

A

Acme Industrial Co. 96
Allegheny-Ludlum Steel Corp. 84
The Allen Mfg. Co. 73
American Broach & Machine Co. 111
B. C. Ames Co. 74

B

Baird Machine Co. 96
Bay State Abrasive Products Co. 15
Bay State Tap & Die Co. 106
Behr-Manning Corp. 99
Bellows Company 93
Chas. H. Besly & Co. 85
Bethlehem Steel Co. 83
Brinnell Co. 102
Brown & Sharpe Mfg. Co. 7

C

Cincinnati Shaper Co. 92
Columbia Tool Steel Co. 88

D

Danly Machine Specialties, Inc. 95
Detroit Die Set Corp. 110
Detroit Reamer & Tool Co. 108
Diamond Machine Tool Co. 110
The Dykem Co. 112

E

Eclipse Counterbore Co. 105

F

Federal Products Corp. 113
Fellows Gear Shaper Co. 112

G

Gairing Tool Co. 71
Geometric Tool Co. 98
Gerotor May Corp. 91
Gisholt Machine Co. 94
Gorham Tool Co. 102
Greenfield Tap & Die Corp. 97

H

Hannifin Corp. 108
Hardinge Brothers, Inc. 3
The Hartford Special Machinery Co. 103
Hauser Machine Tool Corp. 79
Heald Machine Co. 12

K

Keller Tool Co. 4
Kempsmith Machine Co. 110
Kennametal, Inc. 6

L

Landis Machine Co. 14
Latrobe Electric Steel Co. 16
Lufkin Rule Co. 87

M

Majestic Tool & Mfg. Co. 109
Manhattan Rubber Division 72
Merz Engineering Co. 80
Metal Carbides Corp. 107
W. F. Myers Co. Inc. 77
Micromatic Hone Corp. 75
Morton Machine Co. 82

N

National Broach & Machine Co. ..... Inside Back Cover
National Twist Drill & Tool Co. 8-9
Niagara Machine & Tool Works 10-11
Norton Company 86

O

Ohio Knife Co. 76

P

Potter & Johnston
Subsidiary of Pratt & Whitney
Division of Niles-Bement-Pond Co. 81
Pratt & Whitney
Division Niles-Bement-Pond
Co. ..... Inside Front Cover

R

Raybestos-Manhattan, Inc. 72
Ray-Metal Co. Inc. 88
Robertson Mfg. Co. 70
Ruthman Machinery Co. 108
Rutland Tool Service 106

S

Geo. Scherr Co. Inc. 106
Geo. T. Schmidt, Inc. 79
Scully-Jones and Co. 2
Severance Tool Industries, Inc. 104
Standard Gage Co. Inc. 5
Standard Pressed Steel Co. 96
The L. S. Starrett Co. 13
Stokerunit Corp. 114
D. A. Stuart Oil Co. Ltd. 78
Sundstrand Machine Tool Co. 100-101
Swartz Tool Products Co. Inc. 104

T

C. B. Teeter Tool Room Specialties 112

U

Universal Engineering Co. 89

V

Vanadium-Alloys Steel Co. 90
The Van Keuren Co. 102

W

Wales-Strippit Corp. ..... Back Cover
Waukesha Tool Corp. 104
Winter Bros. 8-9
Wood & Spencer Co. 88

Z

W. M. Ziegler Tool Co. 82

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. . . SHAVING
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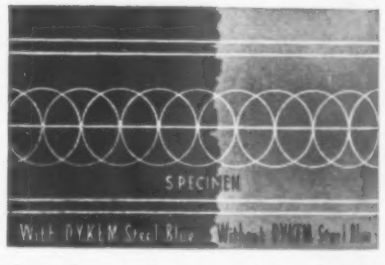

Simply brush on right at the bench; ready for the layout in a few minutes. The dark blue background makes the scribed layout lines show up in sharp relief, and at the same time prevents metal glare. Increases efficiency and accuracy.

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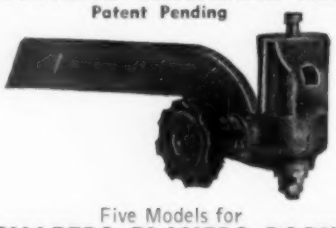

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You can't tell the true cost of a gage until you put it on the job. We see it all the time . . . thousands of dollars wasted in machine time, man-hours, and scrap because inspection gages don't live up to expectations. Old style gages, improperly designed special gages, or inspection tools of the wrong type may be imposing a heavy tax on your profits.

Why put up with this when you can obtain production-proved special gages built by *Gaging Specialists!* Federal Gages have money-saving features:

precision that puts the finger on faulty work

speed that cuts down inspection time

design that positively checks the exact dimension in question

convenience that eliminates inspector fatigue

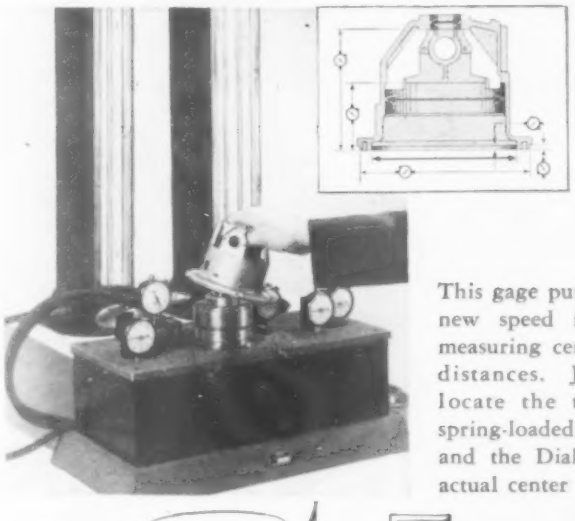
visibility that makes for easier, surer gaging

size readings that are essential to quality control

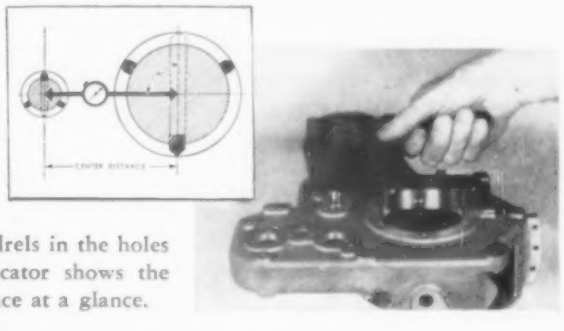
The design of each Federal Gage—manual, semi-automatic, or automatic—is based on years of experience in engineering and manufacturing gages for almost every conceivable dimension.

Whether mechanical, air, or electronic, a Federal Gage is built to deliver real profits in speed and economy. Let us recommend the right Gage for your needs — our nearest representative will be glad to discuss the details of your problem. Or send blueprints and specifications to Federal Products Corporation, 1104 G Eddy Street, Providence 1, R. I.

Here's how FEDERAL solved a couple of inspection problems



◀ A leading vacuum cleaner manufacturer inspects 8 dimensions of motor housings on this combination Air and Dial Indicator Gage. In one time-saving operation, four depths and four diameters are checked simply by positioning the workpiece and taking the dimensional readings.



This gage puts ▶ new speed into measuring center distances. Just locate the two spring-loaded mandrels in the holes and the Dial Indicator shows the actual center distance at a glance.

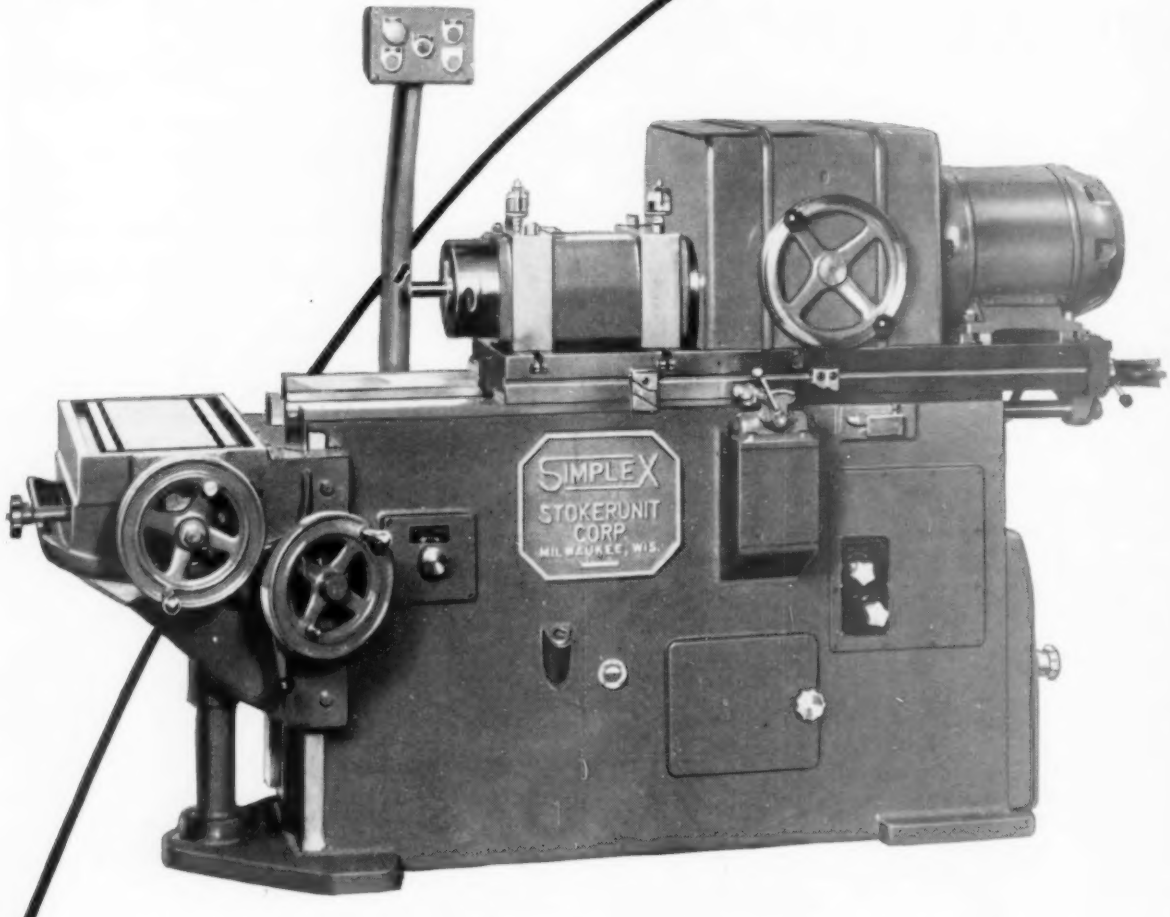
FEDERAL

PRECISION MEASURING INSTRUMENTS

DIAL INDICATORS • INDICATING GAGES • SPECIAL GAGES • ELECTRONIC AND AUTOMATIC SORTING GAGES • AIR GAGES

SIMPLEX

There are times when small production requirements of a wide variety of parts make the selection of a suitable precision boring machine very difficult. The SIMPLEX Knee-Type Precision Boring Machine answers these problems with a highly flexible machine with rapid change-over characteristics.



The SIMPLEX Knee-Type Precision Boring Machine offers a standard precision boring unit with adjustable knee mounted on one end to provide a large range of distance from the spindle center to the top of the table. Table is transversely adjustable on the knee using hardened and ground Vee and flat ways as on the bed and spindle table. The spindle drive is through a variable speed unit controlled by the large hand wheel. A turret stop on the end of the table provides for boring to different depths. With this machine, a few quills and simple fixtures, a wide range of precision boring operations becomes practical and economical.

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SIMPLEX MACHINE TOOLS DIVISION

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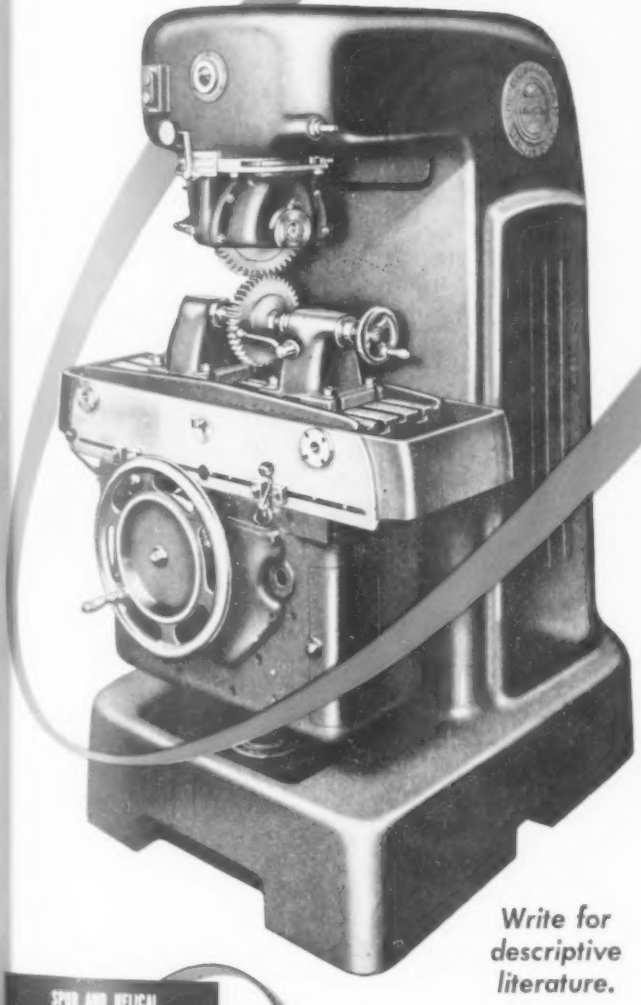

Write for descriptive literature.

This gear shaving machine, the first of its kind, was introduced 16 years ago to fulfill the urgent need of gear manufacturers for a means of correcting precision gears and gears produced to operate under critical loads and speeds—these corrections to bring them within required tolerances.

Today, it is being used by all the leading manufacturers in the automotive industry, the majority of gear jobbing shops and nearly all the machine tool builders.

One gear manufacturer says shaving has reduced rejects which formerly amounted to about 50% to none. Another says that shaved gears have cut operating power requirements approximately 20%.

Gear shaving eliminates the need for skilled machinists, regardless of the degree of precision required. Accuracy does not depend on the shaving machine operator. Shaving also makes it easier to turn out acceptable gears. The teeth of shaved gears have uniform accuracy and the characteristics of all the gears in any lot will be uniform.

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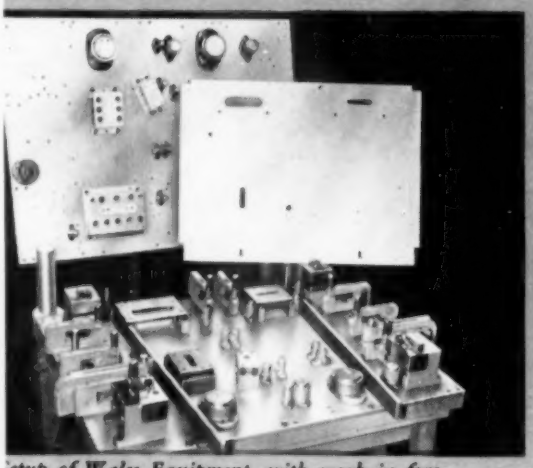
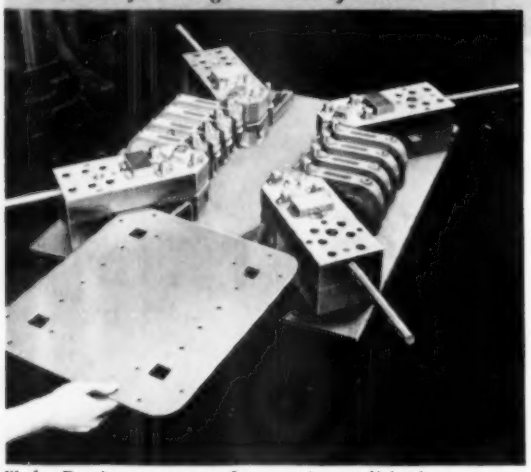
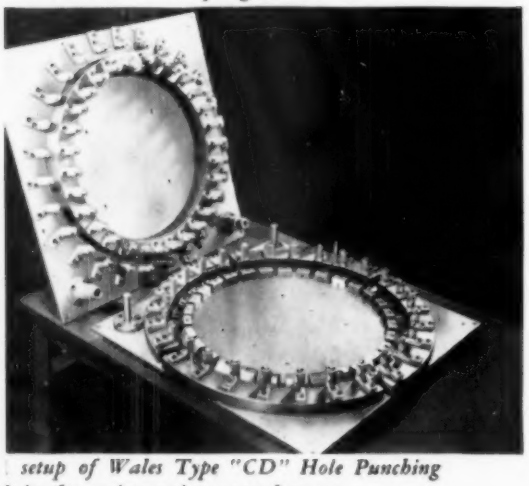


Setup of Wales Equipment, with work in foreground, made for a large stove manufacturer.



Wales Equipment set up for an air conditioning cabinet manufacturer. Note holes and rounded corners in the work in foreground.



A setup of Wales Type "CD" Hole Punching Units for a jet engine manufacturer.

● Wales-Strippit Service Engineers are specialists in hole punching and notching,—selling no other line of equipment. Many of these Service Engineers have had several years' experience in the Engineering and Production Departments at the Wales-Strippit plant. They know from experience what Wales Equipment will do for you. These Service Engineers are as valuable to you as the Wales Equipment. Illustrations of Setups at left are typical suggestions made by Wales Service Engineers. Call them in for suggestions.

AS A FURTHER SUGGESTION

Before deciding on the hole punching and notching portion of your tooling program, check with Wales-Strippit engineers who may solve your particular hole punching problems by using STANDARD adaptations of STANDARD Wales Equipment. Join the large group of leading manufacturers who have made it a rule to call on Wales-Strippit before putting holes in angles, channels, extrusions and sheets by *any* method.

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GEORGE F. WALES, *President*

393 PAYNE AVENUE, NORTH TONAWANDA, N. Y.

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